THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC Servicing & Technology

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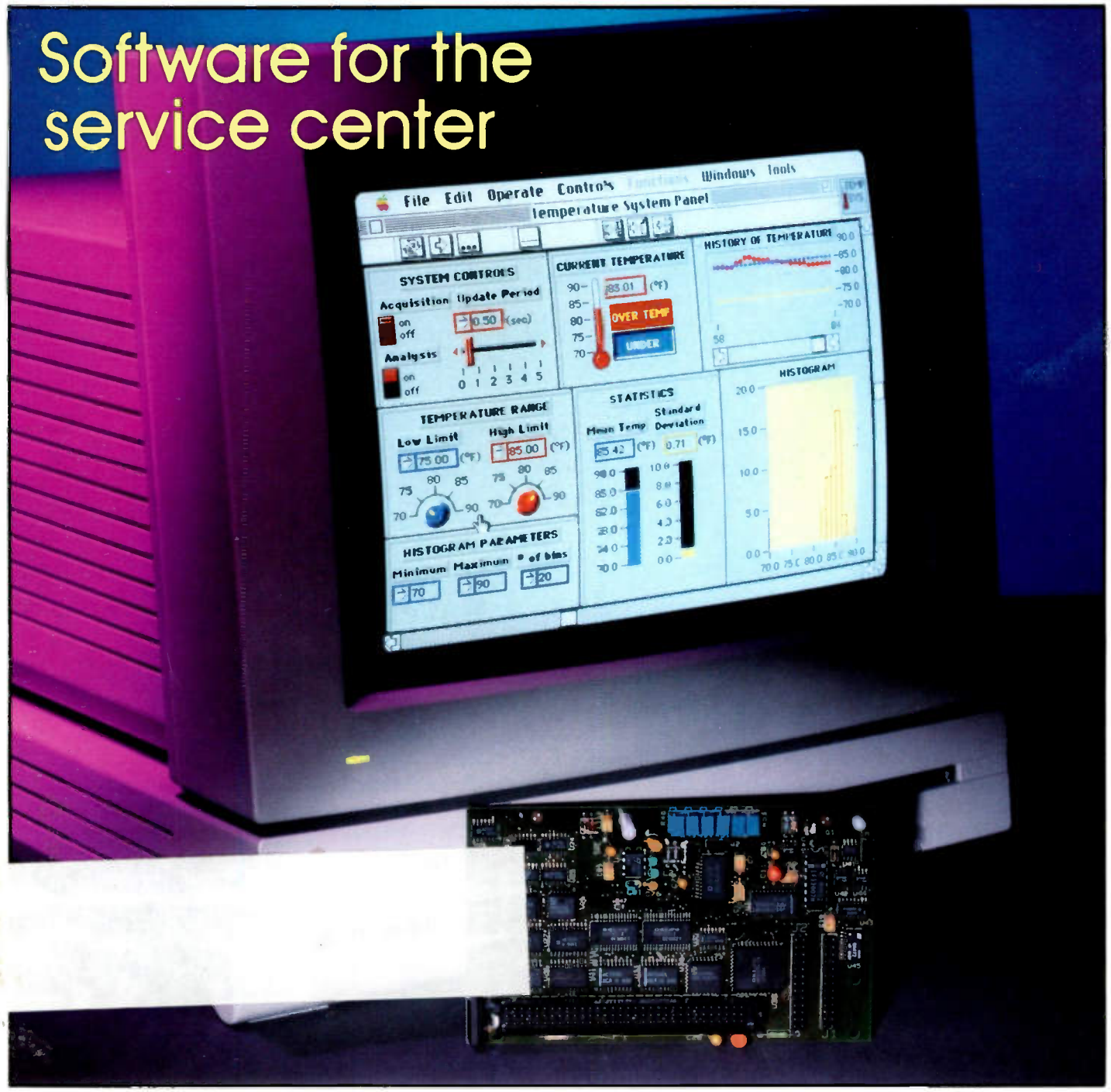
Digital electronics: A little logic goes a long way

Software for the service center



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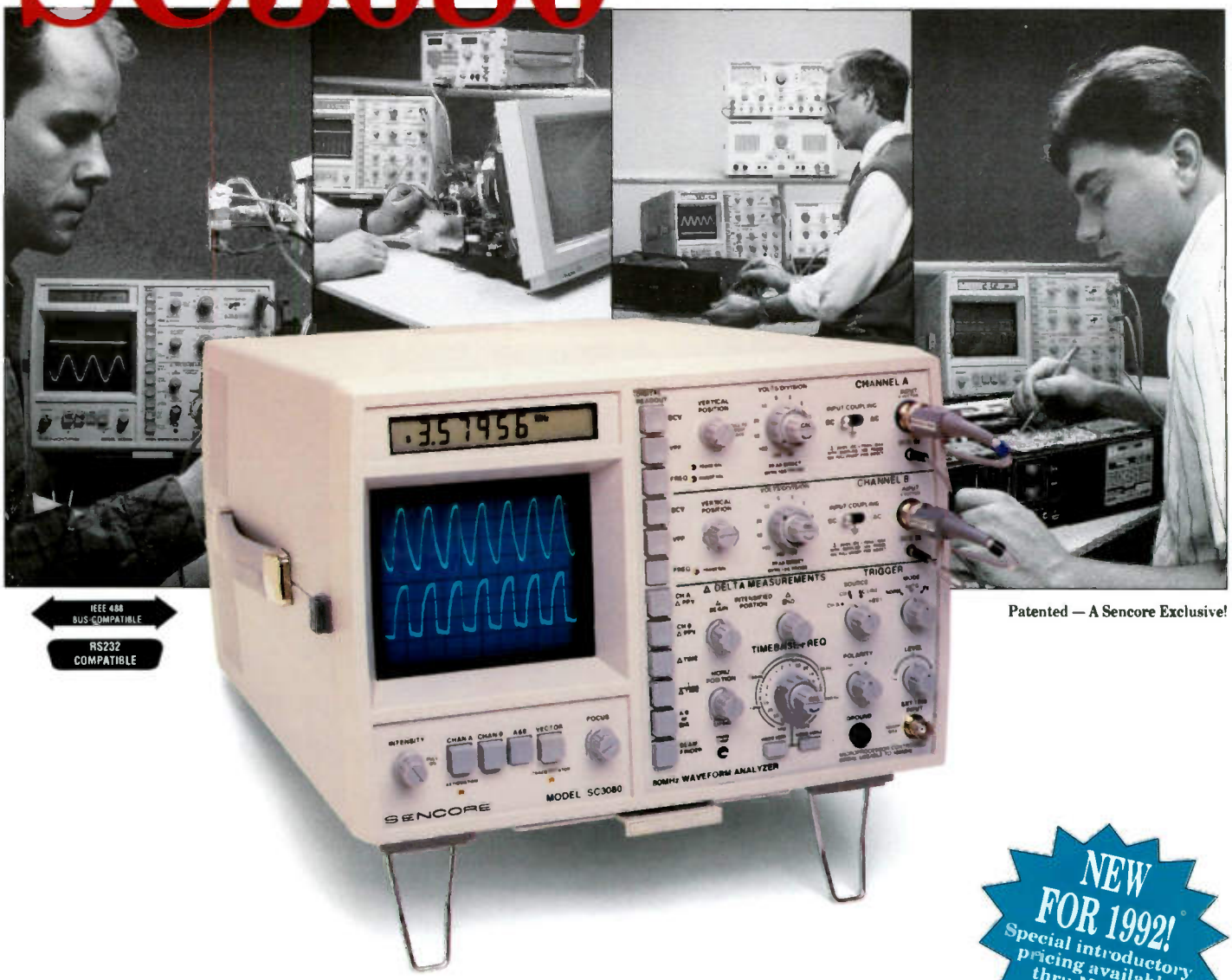

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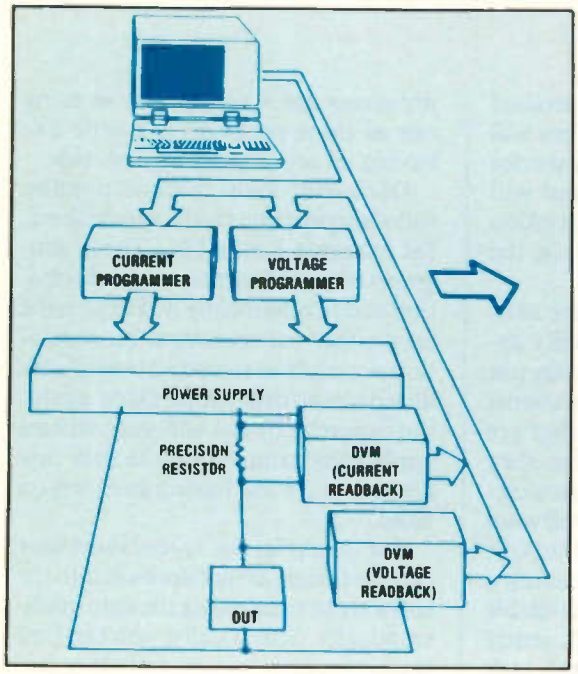
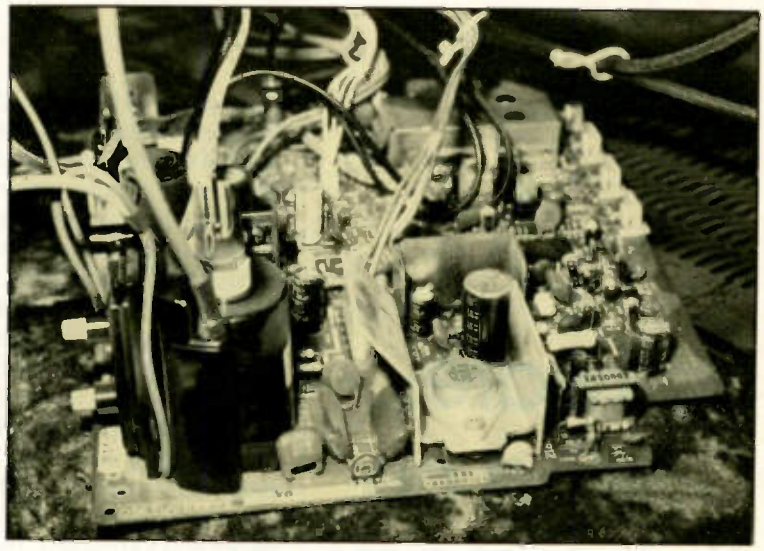
Contents

Volume 12, No. 2 February 1992



page 21



page 12

FEATURES

6 Computer software for service center management
By Conrad Persson
The computer has firmly established itself as a consumer electronics servicing tool along with the oscilloscope, the DMM and the NARDA/NESDA warranty claim form.

12 Troubleshooting Sharp's 19J63 and 19J65 portable TV
By Homer L. Davidson
Every TV set has certain physical peculiarities as well as characteristic failure modes. The Sharp 19J65 chassis is small and requires sharp eyes, patience and careful removal and replacement of components.

17 Digital electronics: A little logic goes a long way
By Lambert C. Huneault
One way to reinforce knowledge is to take a quiz and then have someone explain again the principles behind the subject.

21 Programmable power supplies
By the ES&T staff
Programmable power supplies have been around awhile, but only recently have they become inexpensive and simple enough to use to make them candidates for use in the service center.

38 Curing satellite system electrical interference and interruptions
By Francis J. Stifter
Satellite TV systems are vulnerable to electrical interference from the atmosphere as well as from the power line. This article provides some suggestions on minimizing these problems.

42 A few good ideas for service centers
By the ES&T staff
When service technicians get together, as they do at the annual National Professional Electronics Conference and other meetings, they share ideas for improving service center operations. Here are some of the best ideas to come out of these forums.

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS
ELECTRONIC
Servicing & Technology

DEPARTMENTS

2 Editorial
Software: Calling on the experts

4 Literature

5 News

27 Profax

41 Test Your Electronics Knowledge

45 Audio Corner
AMAX means enhanced radio

46 What Do You Know About Electronics?

48 Computer Corner
Keeping PC hard disk drives up and running

50 Video Corner
Dealing with menus

55 Business Corner
Making the most of your Yellow Pages ad

56 Technology

57 Readers' Exchange

60 Advertisers' Index

ON THE COVER

Software is now available for the source center in three major areas: Service center management software, computer diagnostic software and service tips software. *(Photo courtesy National Instruments).*

Software: Calling on the experts

When you read a professional book, you're doing more than just reading words on paper; you're benefiting from the expertise of the author or authors developed over many years of work at that profession. That's true at least if it's a good book.

The same situation occurs when you buy a well-written software product, but the benefits may be far greater because of the capabilities of the computer. A good software product is more than just something that makes your computer software perform a certain set of tasks, such as service center management; a good software product will not only do that, but it can help make you a better practitioner of your profession. And the reason it can do that is that it is the result of the efforts of some of the best practitioners.

Let's take for example, the service center management software described in the article "Computer software for service center management," in this issue. All of the software products offered by the companies listed in the article will allow you to create, file and retrieve accurate records. They will allow you to create all of the paperwork that you normally create manually, and to track a given product through the repair process. They will assist a technician in locating service literature, ordering parts, and will even help him write up the description of the nature of the trouble and the service work performed.

One of the benefits of these software packages that is not readily apparent on the surface is that they not only help the service center personnel perform the standard tasks that are performed in the service center, they force them to perform them in a certain way. Assuming that the software package is a good one, this is the right way. This has the effect of having a highly trained service person available to all service center personnel, gently guiding them to perform each task correctly.

This same situation is true, to a greater or lesser extent, of any kind of well-written software. For example, the software with which I am most familiar is word processor software. This editorial is being composed on a personal computer using a word processor. As I type, the page is automatically formatted to be a certain length, with certain margins. If I print this out, it will look pretty good. Much better than if I typed it. And anytime I make a mistake, I can just back up and correct it. If I make errors in spelling, the spell checker will catch most of them.

If I wish to use it, I even have a grammar checker which will analyze the document and make suggestions on how to improve the grammar of the document. This software also has limitations, especially in the case of technical documents, but used judiciously, it can improve the quality of writing for just about anyone.

There are several financial programs offered by a number of companies that allow the user to manipulate just about all of his finances, as well as other personal information. For example, you can keep a record of your checkbook information, and the program automatically deducts the amounts for checks written and adds deposits. You can even flag checks for amounts that are tax deductible. In this case, the experts who wrote these programs are accountants, so using one of these packages is a little like having an accountant at your side.

Of course, one of the most popular software programs is the spreadsheet, for example Lotus 123. These programs allow the user to enter information and to manipulate it. They can be used either for numerical manipulation or simply to store and manipulate database information. Once again, the expertise of the software writers apply constraints upon the user that are very much like having an expert on hand.

For example, the spreadsheet user can use formulas that are built into the software to manipulate the data mathematically. Specifically, you can find the average, the mean, and other statistical information about the entries. You can take the sum of a number of entries. You can find trigonometric functions or logarithmic functions of entries. But you must use the formulas according to the rules built into the program, and that means that you are receiving the guidance of the program's writers.

Something that we have not covered in this issue, primarily because it is really still in the future for consumer electronics servicing, if it will ever be used at all, is expert system software. In this case, the software becomes the expert diagnostician. The experience of the designers, manufacturing personnel, servicing professionals, and others who have had some connection with a product, is combined in a software package that can then be used by servicing professionals to guide them in servicing a product.

Computers have had a profound effect on the way we live and work. One of the most important but little appreciated of these effects, is to bring the expertise of the software writers to the computer user, which in many cases allows the computer user to do his job faster, more accurately, and in a way that makes the results easier to save and retrieve. ■

Nils Conrad Persson

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Literature

Fiber optic newsletter

The latest issue of the "Fotec Fiber Optic Testing News" has just been printed. It is a quartely publication devoted to topics related to fiber optic technology, applications and testing, published by Fotec, Inc., the Boston-based fiber optic test equipment company. The latest issue has a lengthy article on planning a fiber optic network, including what kinds of fiber to install and how to plan the network architecture. The issue also details new product information and an update of the company's schedule of seminars.

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Instrument catalog

Datel's newest 210 page industrial monitor and control handbook includes data sheets, illustrations, specifications, and applications for the entire line of LED and LCD digital panel meters, printers, process monitors, and calibrators, as well as a summary guide for data acquisition boards, dc/dc power converters and other data conversion products. Featured in the catalog are the low cost 3 1/2 digit DMS-30 and DMH series of advanced technology hybrid digital voltmeters. These component-like modules are fully functional digital voltmeters available in a choice of 30 different colors. The LED versions (DMS-30PC) operate from 5Vdc and draw as little as 15mA of current (DMS-30PC-RL) at 5Vdc. The LCD versions are available in either 5Vdc or 9Vdc primary operating power drawing as little as 200μA and 9Vdc. Datel also carries a complete line of DIN size panel instruments and DPMs along with process monitors for thermocouples RTDs, current, volts and strain gage inputs.

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Home automation catalog

"Computerize your home" declares the new Home Automation Laboratories mail-order catalog, based in Atlanta, GA. Once the exclusive domain of custom high-end (and high cost) specialists, home automation equipment is now easy enough and inexpensive enough for anyone to buy after reading the HAL catalog, according to the company. One example is X-10 system modules (originally marketed by BSR) that can control lights and appliances from anywhere in the house by sending signals over your existing power lines. X-10 offers modules for plug in lamps and appliances wall switches and many specialized applications like ceiling fans and hot water heaters. About half of the 400 or so products in the catalog can be controlled directly from an IBM compatible personal computer using HAL's Dynasty software which lets you program your lights, heating, and air conditioning, audio/video, telephone and security system to respond to your every wish.

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Brochure available on technical computer courses

A new brochure describes nine intensive short courses available from Learning Group International. Topics covered in the courses include: hands on pc configuration and troubleshooting, advanced pc configuration, computer graphics, relational databases, hands-on SQL, digital signal processing techniques, and more.

This brochure outlines each course and describes: the subjects and applications covered; the hands-on activities; benefits; materials provided, authors and instructions; dates and locations, and who should attend. The 4-day programs, priced from $1795.00 to $1895.00, are offered throughout the United States, Canada, and Europe. Assistance is available to arrange for On-Site training presentations.

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Training course calendar

A 1992 pullout calendar that lists a complete range of intensive short courses in software development, communications, electronics and technical management, is offered by Learning Group International. This color-keyed calendar lists dates and locations for more than 45 course subjects scheduled throughout the United States and Canada. The 4-day course are offered in major citires which include Washington, D.C., Boston, Los Angeles, San Diego, San Fransisco, Ottawa and Toronto. Course prices range from $1795.00 to $1895.00. ■

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EIA engineering department initiates digital audio broadcasting standards activity

The Electronic Industries Association (EIA) has initiated standards activity relating to digital audio broadcasting, and is active in developing information and consensus on other key technologies.

Digital audio broadcasting (DAB)

Activity has begun that will culminate in the selection of a digital audio radio service. EIA has formed a committee that will collect information from DAB system proponents, formulate test methods to evaluate potential systems, oversee proponent testing, establish system selection criteria, and develop a voting procedure through which a final DAB system or set of criteria will be recommended to the Federal Communications Commission (FCC) for adoption.

Digital video workshop

EIA recently held the third annual Digital Video Workshop. The workshop provides an informational forum for engineers and technical managers to discuss the rapidly growing digital video field. Topics addressed the application of digital compression to advanced television systems, and near video on command for cable television systems.

Closed captioning standard

EIA created a cross-industry committee to develop standards to be submitted to the FCC. The FCC has accepted EIA's suggestions.

HDTV

As more sophisticated ways to receive programming are being created, EIA's Advanced Television System Receiver Interface Committee is discussing ways to make the connection to an HDTV set an easy proposition at minimal cost to consumers.

CEBus

The entire CEBus standard has been written, and is currently moving through the approval process. Portions of the overall standard that have been recently approved are the twisted pair and infrared sections. The coaxial section is close to being approved, as is a major portion of the protocol section.

Radio broadcast data systems (RBDS)

RBDS standards activity will allow radios to be "smart," so that they can automatically switch to targeted informational services such as traffic alerts. Other services that radio may one day be able to offer include displaying radio station call letters, program scanning by format, automatic traffic alerts, and clock synchronization signals (for radios with clocks).

VCR decks, color TVs/VCRs, projection TV sales up in October

Sales to dealers of VCR decks, color TV/VCR combination units and projection televisions were up in October 1991 versus the same period last year, according to statistics released today by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Sales of color televisions 27 inches and larger were up 15 percent through October 1991, even though overall sales to dealers of color TVs were down 7.1 percent in October 1991 versus October 1990 figures. Sales of color TV/VCR combination units were up 17.0 percent during that period.

VCR decks posted an 8.2 percent increase in October 1991 versus the same period last year. Total sales of VCR decks to dealers in the first four months of the second half of 1991 were up 14.2 percent from the same period in 1990.

Projection TV sales were up 20.8 percent in October 1991 versus figures posted in October 1990. Total sales to dealers of projection TVs in the first four months of the second half of 1991 were up 25.4 percent over same period in 1990.

Camcorders posted a 37.6 percent loss in October 1991 versus the same period in 1990, although total sales to dealers in the first four months of the second half of 1991 were down only 7.7 percent over the same period in 1990. ■

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Computer software for service center management

By Conrad Persson

In just a few short years, the personal computer has revolutionized the way people do their work. Not too long ago, if you went into your doctor's office, or any of a number of small businesses, when you gave them your name they went to a file cabinet and pulled out your records. Today they ask you for your telephone number, punch a few buttons on a computer keyboard and print out your record.

Writers who used to slave all day over a hot typewriter, yanking sheets of paper and crumpling them up and tossing them away when things weren't coming out right, now instead slave over a hot computer keyboard and when they don't like the way things are going, they might delete a portion of a file with a few keystrokes, or simply rearrange things by using a word processor's commands.

Just a few years ago, a few visionary consumer electronics service technicians changed the way they did things using computers. They recognized that a personal computer, or a network of personal computers, would be perfect for taking care of all of the administrative tasks that are required in a service center. Since that time, more and more service centers have converted from the old cumbersome paper approach to entering information, tracking products through the servicing process, preparing parts orders, preparing invoices and billing, to a computerized system that does all these things but has the added advantage of allowing instant access to any of this information at any time from any place in the service center. Since that time, more and more service centers have turned to computers to make their operations more efficient.

Persson is editor of **ES&T**

More than just service center management

Now service centers are turning over even more and more tasks to the computer. One example is the filing of service tips. Traditionally, many service centers have file drawers full of service tips. The personnel at the service center carefully document every service procedure they perform; the symptoms of a problem on a particular set and the nature of the trouble found. They file this information, along with tips they receive from manufacturers and other sources.

In the exceptionally well-managed service center, this information is properly filed and accessible when a particular brand and model of product is being serviced. In the less well managed service center, sometimes the information desired can be found, and sometimes not. Even in the well managed service center, however, the process is cumbersome, and if one service technician has a particular tips file, it might not be available to another technician who needs it.

By filing all of these service tips in a computer data base on a networked computer system, all the service tips are available readily to any technician at any time, using just a few keystrokes.

Diagnostics, too

While computers are helping service centers file and retrieve information, computers that require servicing are also providing service centers with a source of revenue. Many service centers have added personal computers to the list of products that they service. Unlike things like TVs, VCRs, CD players, etc., computers can tell the servicer what's wrong, to a certain extent at least.

When a personal computer is exhibiting a problem, but some of the vital portions are still functioning, it's possible to put a disk into the computer that contains a software program that was written so that it exercises certain portions of the computer, and reports back if everything is working properly, or provides a report of the nature of the problem if a problem exists.

Here's a rundown of the software as we know it Whether you've been computerized for the past five years, or plan to do so next year, whether you have all your service tips on a computer or have been thinking about doing it, or whether you've been servicing computers for years or think you might get into it one of these days, this article might provide you with some useful information. What follows is a description of some of the features of some of the software mentioned above, accompanied by a list of companies who offer this software for sale.

Service center management

Service center management software provides support for the servicing facility in just about every aspect of the business. With one of these packages, when a product is brought in for service you enter the customer's information and the nature of the complaint. If this is a repeat customer you may just have to type in his phone number, and the rest of the information is brought up automatically from the computer data base.

Here's a rundown of some of the features of a software product that provides a broad range of service center management capability. Because software such as this can vary considerably in its usefulness, depending on the particular needs and management style of the managers, we

recommend that before making a commitment to purchase such a system that you compare the features and ease of operation of several packages.

Job tracking/scheduling

As the customer's job information is entered into the system, the computer automatically creates a job ticket and stores the information. Now you can do several things:

- Easily handle customer phone inquiries. Just enter the customer's phone number or name and the job information is on the screen.
- Instantly access a job's current status just by supplying the appropriate code number.
- Get detailed job status information.
- Maintain a complete history of each unit by serial number or by customer number.
- A summary schedule lets you see the whole day's schedule at a glance.
- You can do scheduling by territory.
- Obtain a printout of both technician routing sheets and a management summary sheet.

Inventory management

The inventory program gives you the individual parts movement by the month, cross reference data, prices, quantity and a re-order report. By checking the movement record, you can adjust quantities ordered to make sure you have adequate inventory of parts without being stuck with a large inventory of slow-moving parts. By coupling this information with manufacturer's shipping time, you can order replacement parts early enough to cut down on back orders.

Invoicing

With some programs, you may enter repair descriptions and labor pricing ahead of time. The information is then on record allowing you to automatically invoice by making number selections for repair descriptions and labor prices. In addition, this program segment allows you to print both customer and standard NARDA invoices and to automatically print post cards informing customers of the status of their unit.

Codes and tables

User-defined codes and part pricing

Electronic Service Center Owner's Survey

8 OUT OF 10 BUSINESSES ARE NOT READY — IS YOURS?

Are You Losing Track Of Where Your Service Work Is?	☐ YES	☐ NO
Are You Having A Difficult Time Locating Customer Repairs?	☐ YES	☐ NO
Are You Losing Service Work Because Of Poor Inventory Control?	☐ YES	☐ NO
Are You Having A Hard Time Figuring Out Whether Or Not A Technician Is Making You Money?	☐ YES	☐ NO
Are You Stuck With Repaired Inventory The Customer Never Picked Up?	☐ YES	☐ NO
Are You Frustrated Waiting For Warranty Claim Payments?	☐ YES	☐ NO

If you answered "YES" to any of the questions above, you're not alone! One of the largest challenges that Electronic Service Centers are facing today is management hassles. Managing inventories, parts ordering, warranty repair billing and customer relations is enough to keep an army of secretaries occupied – no matter what the size of the service center.

Sencore and **IBM** have developed an electronic service management system that will virtually eliminate all your management troubles and give you more time to do what is truly important: REPAIRS.

To find out more about this innovative new way to manage your business, call your Electronic Service Management System Specialist at

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tables let you customize your system and speed up data entry. All the technician needs to do is to press a special key to see the list of possible code entries. They include codes for unit types, brands, manufacturers, technicians, status of jobs; e.g., parts on order or estimate, customer approval, return shipping method, sales taxes, vendors.

Forms and reports

A service management software system can save you time and money in several ways by doing much of the paperwork for you. First, a valuable technician will have to take less time away from repair work to do paperwork. Second, you only have to enter the customer data once. After that, the computer will automatically generate the information in the proper format to match your different forms. Finally, the various computer generated reports allow you to see where your money is going and how fast. Some of the forms and reports that are available are: management reports, such as daily work in process report, work completed not picked up, technician unit report, technician productivity report, production detailing report, job tracking/scheduling. Also available are invoicing reports, warranty and service literature information and inventory management.

Yet more computer help

As wonderful as these computer programs are, one thing is absent from their capabilities: input from and communication with the manufacturers. At least two systems now include communication with the manufacturers as part of their features.

For example, one such system, OASIS by KeyPrestige, provides information from subscribing manufacturers to service centers. Once a manufacturer subscribes to this system, a manufacturer's specific data base is created and continually maintained, Service centers can access this data and obtain information on claims, parts availability and pricing, technical bulletins and more, as authorized by the subscribing manufacturer. A service center that wishes to access this system only needs to have a PC and the appropriate communications software.

When the user connects with the central source mainframe, they instantly have access to all authorized information. The screens are all menu driven and easy to use, and on-line help is available, according to the company.

Current menu options

A user can make as many or as few inquiries as desired with each dial-up session. Status can be checked with one or several subscribers on the following items:

Claims - A user can inquire about the status of claims. Included in this screen is all the necessary claims information. A window at the bottom of the screen will display any additional information that is applicable, including any reason for rejection or non-payment.

Parts - This screen will display part numbers, descriptions, availability and applicable prices.

Bulletins - This feature offers users technical information to assist in repairs. Users can order bulletins or print them in- house while on-line.

Future options - According to the manufacturer, options that will be added to the software in the future are parts ordering, electronic transmission of warranty claims, special announcements, and more.

Electronics service management system - Another provider of software for consumer-electronics service management is IBM. According to that company, their new product is a new software offering for small- to medium-sized independent consumer electronics service centers.

The software is intended to speed and simplify operations by allowing repair shops to communicate directly with various manufacturers from their personal computers in order to: process warranty claims, order parts, deliver pricing and technical information.

In addition, says the manufacturer, ESMS provides important service center management applications, such as work order processing, parts inventory, cash drawer, customer letters and technician evaluations.

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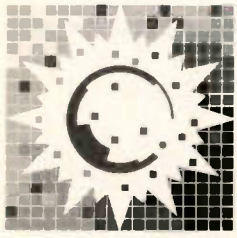

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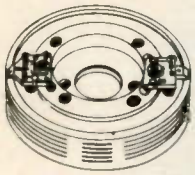

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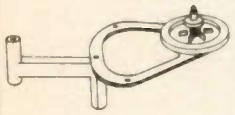

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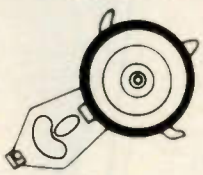

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One other comment: these systems are probably not for every servicing facility. A low-end system, software only to run on your own PC may cost several hundred to over a thousand dollars. A high end system for a large shop, software or software and hardware, may cost several thousand dollars. On the other hand, if a shop is large enough to use one of these systems, and the people who will use it are dedicated enough to making it work, the benefits may well far outweigh the cost. ■

Troubleshooting Sharp's 19J63 and 19J65 portable TV

By Homer L. Davidson

The 19J65 chassis is small and requires sharp eyes, patience and careful removal and replacement of components (Figure 1). In fact, the chassis is so small that it looks like a miniature when it's in the larger plastic cabinet. Here are a few of the troubles that I have encountered on more than one occasion in these two portables.

When I began working on one set, I found that the 4A line fuse, F701, was blown and there was no voltage at the collector of Q802. Suspecting a shorted diode in the power supply, I checked all four diodes in the bridge circuit using the diode test of the DMM. The diodes were all sound. After I replaced the fuse, and again applied power to the set, I measured voltage at filter capacitor C706, but the low voltage at the anode terminal of SCR701 (Figure 2) was zero.

Closer scrutiny of the schematic revealed that part of the flyback winding of T802 is in series with SCR701. A continuity check from filter capacitor C706 to the anode of SCR701 showed that there was an open circuit somewhere. Either the flyback winding was open or there was some broken wiring. When I examined the flyback terminals, I found some poorly soldered joints that had corroded. Resoldering both connections restored low voltage to the anode of SCR701. Now, however, the voltage at the cathode (K) of SCR701. TP701 measured higher than normal at 157V.

The gate voltage at SCR701 measured 150V. As a result of these measurements, I suspected that SCR701 was leaky, a suspicion that was verified by further in-circuit tests. I then removed SCR701 from the circuit and tested it again. These tests confirmed that SCR701 was leaky. Because I did not have an exact replacement on hand (354 M), I checked the semiconductor universal replacement guide. According to the manual, either a 6E5457 or ECG5457 could be used as replacement for this SCR, so I used one that I had on hand.

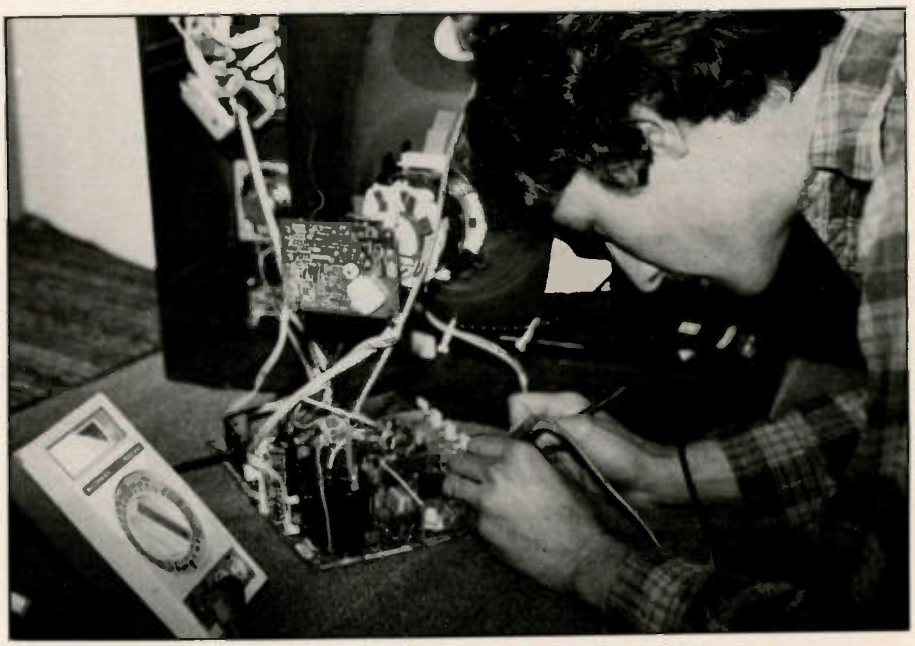

Figure 1. Here the technician is making low resistance measurement in the Sharp 19J65 portable TV.

While SCR701 was out of the circuit, I tested all parts that were connected to it. All tested normal except ZD701 and R706. ZD701 was leaky and the resistance of R706 had decreased to 101Ω. Again, I did not have the manufacturer's exact replacement part (EX0106CE) on hand, so I checked the semiconductor replacement guide. Parts number GEZD-82 or SK82A/ECG5047A were listed as replacements. Replacing components SCR701, ZD701 and R706, and soldering the flyback transformer terminations (1 and 2), brought the dead low voltage source back to life and restored the set to normal operation.

Keeps blowing fuses

One completely dead set was brought into the service center. A quick check revealed that the line fuse was blown. I replaced the 4A line fuse and reapplied power to the chassis. F701 opened again. A quick resistance check from the horizontal output transistor collector to ground did not show excessive leakage (Figure 3). Suspecting that the low voltage diodes or filter capacitor might be leaky, I checked the low voltage circuits. No problem here.

Again, I checked Q602 but it showed no sign of leakage. I replaced the fuse, and this time when I applied power to the set the fuse did not blow. Voltage checks showed that there was no low voltage at the collector terminal of Q602 (131V), and there was still no raster or high voltage. Even though in-circuit resistance measurements did not point to Q602 as the cause of the problem, the other signs suggested that it was. I removed Q602 from the chassis (heat sink and all), and tested it. Q602 was in fact leaky (0.56Ω). I replaced Q602 with an SK9119 universal replacement.

After replacing Q602, there was still no high voltage. The chassis seemed to

Davidson is a TV servicing consultant for ES&T.

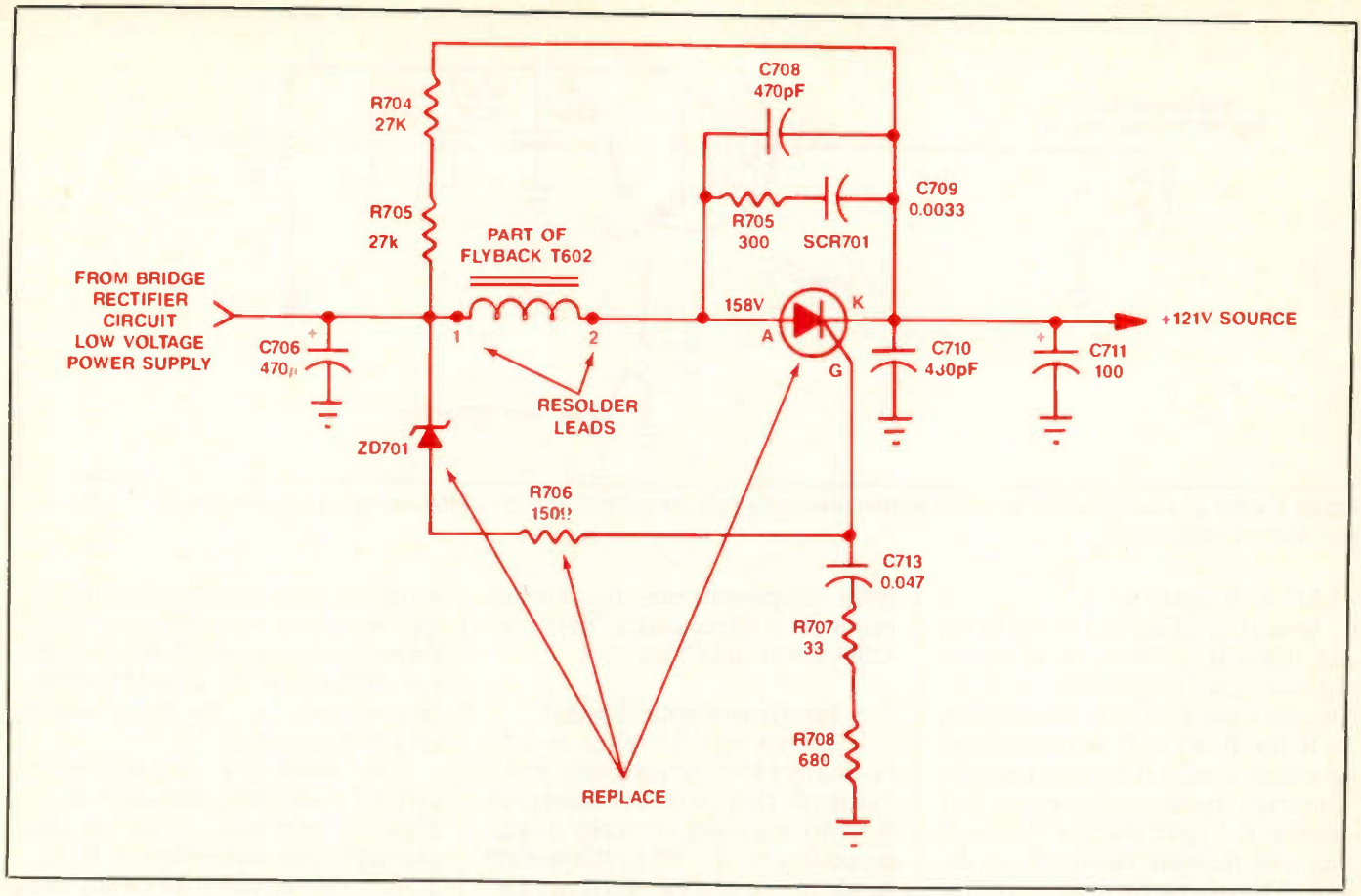

Figure 2. The symptom in this set was caused by a leaky SCR 701, R 706 and leaky ZD.701.

be motorboating. The B+ applied to Q602 was rising and lowering rapidly. I remembered that in another set in which this same symptom occurred, the cause of the problem was an open emitter resistor. Resistance checks revealed that, sure enough, resistor R619 (0.33Ω) was open. I replaced R619 with a 1W resistor (Figure 4), which restored the set to operation. I should have checked this resistor before replacing Q602.

Why did Q602 blow the fuse when the emitter terminal was open? Or, did Q602 open up the fuse? But Q602 was leaky at 0.56Ω. I assumed R619 was intact when the fuse blew and when Q602 was replaced R619 came apart. The resistor was found charred and in two pieces. When Q602 was measured the first time, the damper diode inside the horizontal output transistor should have shown a normal measurement in one direction. No doubt I neglected to reverse the leads on the DMM to get this measurement the first time.

No vertical sweep

Only a horizontal white line appeared on the screen of a 19J65 portable that was brought in for service. Since high voltage and horizontal sweep were both normal, a quick scope waveform check at pin 26 of IC801 indicated IC801 was good. The vertical waveform that should have been found at pin 2 of IC501 was missing (Figure 5).

I checked the voltages at the pins of the vertical output IC and found that they were all low. The voltage at pin 3 was only 1.2V. The source of the voltage for IC501 (23.5V) is the secondary winding of the flyback (T602), so I checked the components in that part of the circuit. D502 tested normal, but resistor R522 (1Ω) was open. Although D502 tested good, both D502 and

Figure 3. A leaky horizonal output transistor Q602 in one set caused the fuses to blow. Remove Q602 assembly with heat sink, by unsoldering board terminals.

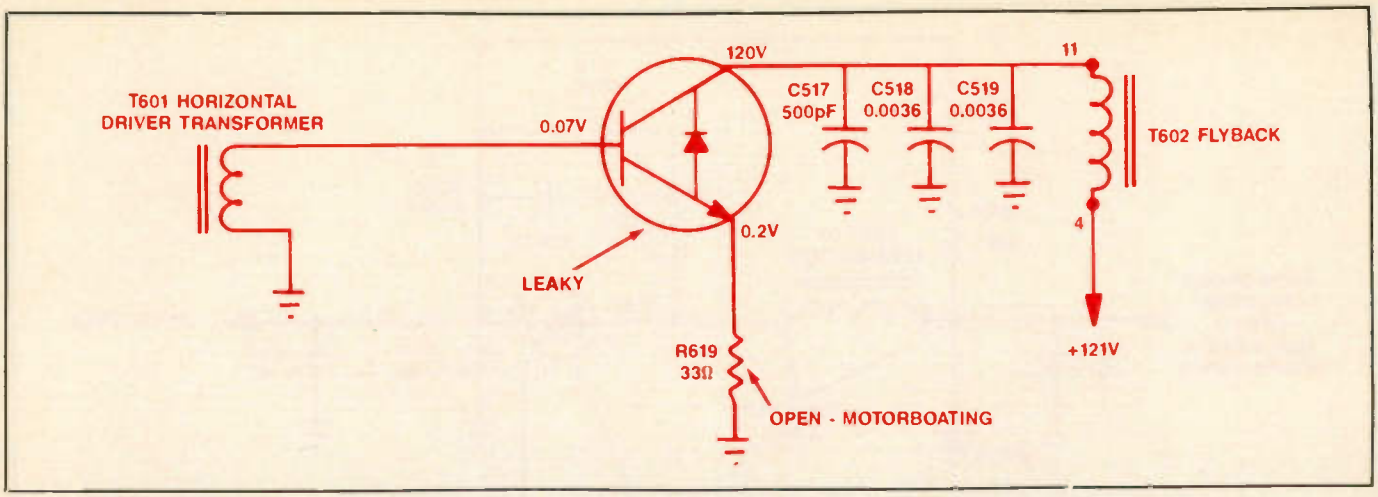

Figure 4. Q602 was leaky and R619, (3.3KΩ emitter resistor) which caused motorboating after replacing horizonal output transistor with SK9119 replacement.

R522 were replaced.

When I again applied power to the set, there was still no vertical sweep. I disconnected the set at once and performed a leakage test at all terminals of IC501. Pins 3 and 7 showed leakage to chassis ground. Because there is no universal replacement for this IC, part number RH-1X0238CEZZ, I ordered one from the manufacturer's part depot. When the part arrived, I installed it, which restored the set to normal operation. I can only conclude that IC501 became leaky, which caused excessive current through R522, destroying it.

In another chassis, a defective R509 caused another type of problem. This resistor had increased to 48K, which resulted in vertical foldover. Several other components can cause vertical problems in this chassis: C505, C506, C509, C510 and C512.

Insufficient vertical height

Improper vertical sweep may be caused by a low voltage source with a voltage that is too low, inadequate vertical drive voltage, or leaky output transistors or IC. When the vertical height in one of these sets is not correct, perform a quick waveform test at pin 26 of IC801, vertical deflection and driver amp. The vertical drive pulse at pin 4 of the vertical output IC, IC501, should be around 1V and measure about 1.95Vpp.

On one set that was brought into the service center with the complaint of insufficient vertical height, the output waveform at pin 2 was one-half the required vertical sweep (27Vpp). Measurements of the circuits that supply low voltage to IC501 showed them to be normal. In fact, the supply source (pin 3) measured 22.7V.

I shut down the chassis and made critical resistance measurements. Most of the resistors in the vertical output circuit were normal. R516, 1.5Ω in the vertical yoke circuit was good. The yoke resistance was normal at 17Ω.

Because electrolytic capacitors in the output circuit may sometimes be the cause of insufficient vertical sweep, I began looking at that possibility in this case. Upon checking the schematic I noticed that the location of C510 was such that if it became

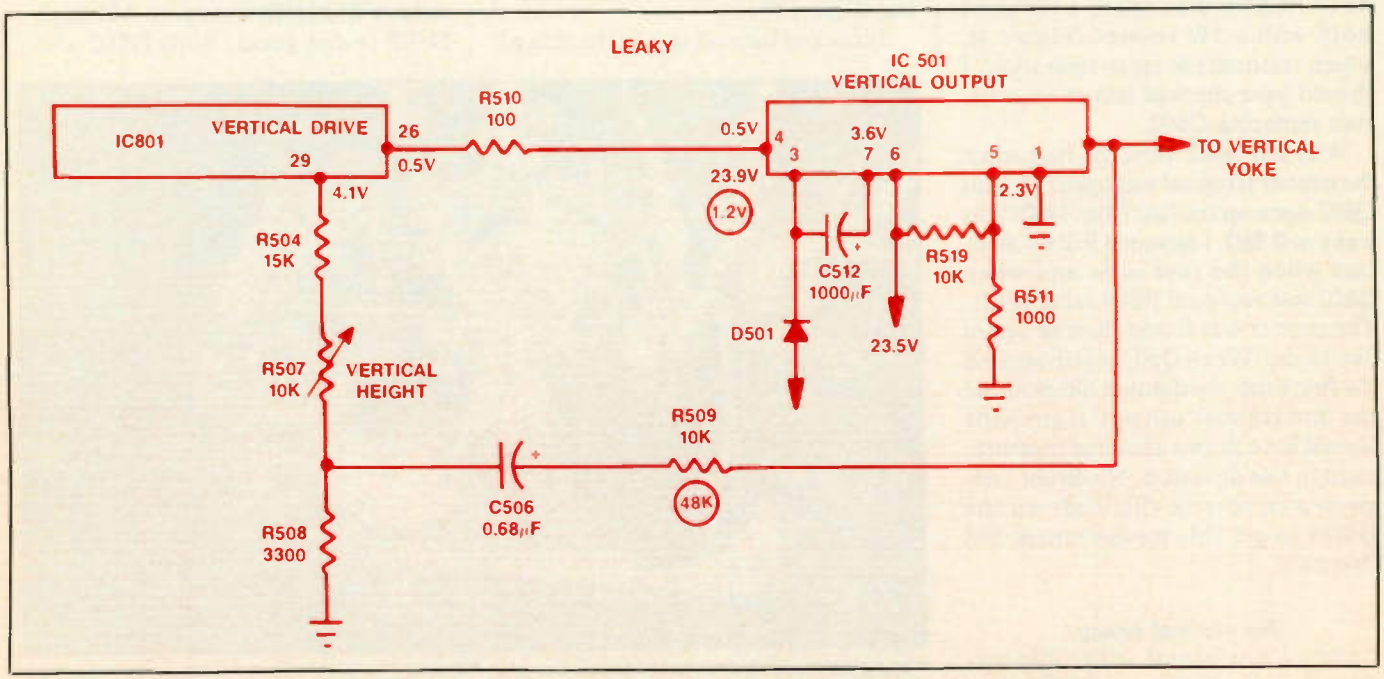

Figure 5. No vertical output waveform was found at pin 2 of IC501 resulting in the absence of vertical sweep.

open it might be the cause of the sweep problem. When I bridged C510 with another 1000μF capacitor the picture returned to normal (Figure 6). Replacement of C510 with a 1000μF, 50V electrolytic capacitor restored full vertical sweep.

Horizontal white line

One set that was brought in had no picture. The face of the picture tube showed just a horizontal white line. Something had interfered with the vertical sweep. Failure of just about any component in the vertical driver or output IC circuits can cause the absence of vertical sweep. A quick scope check at output pin 2 of IC 501 showed no waveform. No vertical drive waveform was found at input pin 4 of IC-501. The same results were found at pin 26 of IC801 (Figure 7). Either IC-801 was defective or IC501 was loading down the vertical driver input signal.

I took voltage and resistance measurements at the vertical output IC, IC501. All values were within specification. This led me to conclude that IC501 was normal. Sometimes when the vertical hold control was rotated, the raster would flash upward and collapse. Voltage measurements at pins 27, 29 and 30 were fairly normal. When R505 and R507 were rotated, the voltage changed only a few volts at pins 30 and 29 respectively.

Because there was no vertical drive signal at pin 26, even though all of the voltages supplied to it were within specification, the only logical explanation was that the vertical circuits inside IC801 must be defective. I replaced RH-IX0212CEZZ with an SK7676 universal replacement, which restored vertical drive.

No vertical or horizontal sync

On one set we serviced, neither the horizontal hold control (R609) nor the vertical hold control (R507) would lock in the picture. I tipped the chassis to one side to gain access to the terminals of IC801. This IC is hard to get to because it's located right under the bell of the picture tube. I clipped one end of a ground clip wire to the tube grounding strap and the other end to the IF shield for proper ground.

The sync signal for this set is taken from pin 7 of IC801. A quick check of pin 7 indicated normal sync pulses. The same signal was scoped at pin 39 of IC801. Next I measured the voltages at all terminals of IC801. The voltage at pin 30 was a little higher than normal (5.7V) and pin 33 was high at 10.2V. Although these values varied when the horizontal and vertical hold controls were rotated, they were a few volts higher than normal. Most voltage measurements were right on the nose.

Still suspecting IC801, I sprayed it with coolant to see if it was sensitive to changes in temperature. There was no change in symptoms; the picture remained out of sync both horizontally and vertically. Given this set of symptoms, I could only conclude that IC801 must be defective. Although it's quite a job to replace IC801, the suspected IC was replaced with ECG1547 universal replacement, which restored the set to operation.

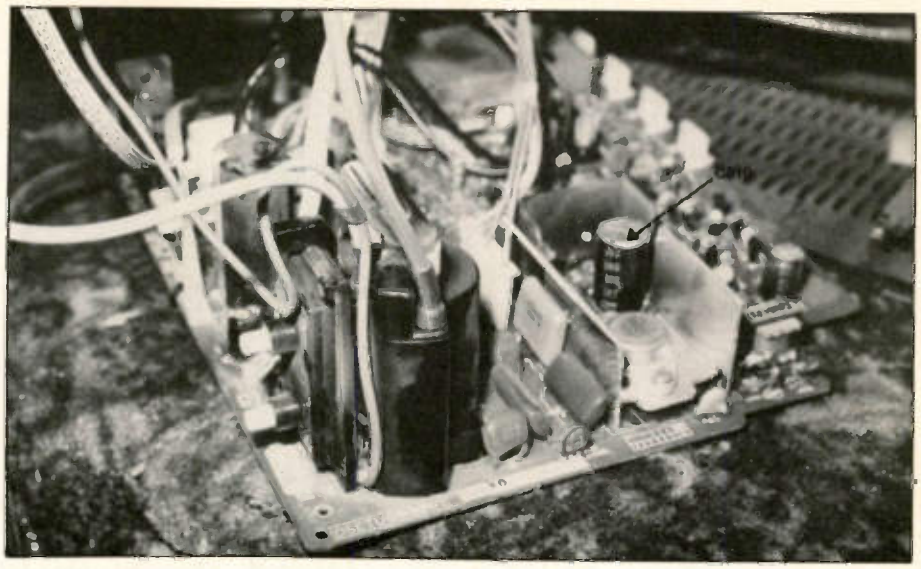

Figure 6. Insufficient vertical height was caused with a defective C510 (1000μF) coupling capacitor.

Very little brightness

On one set that had a dark picture,

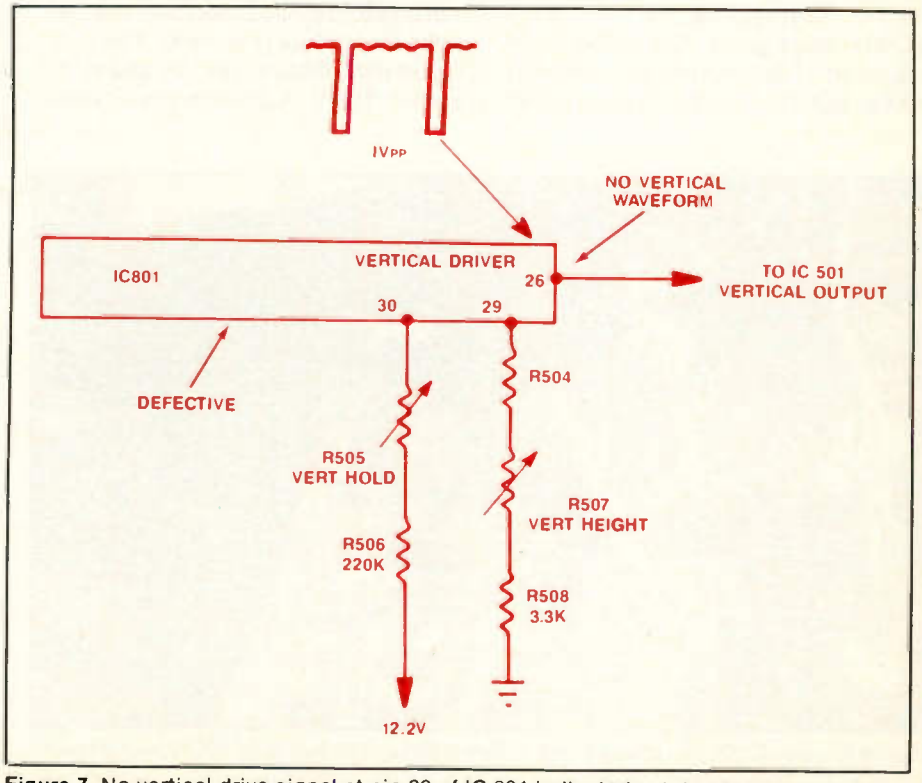

Figure 7. No vertical drive signal at pin 26 of IC 801 indicated a defective IC.

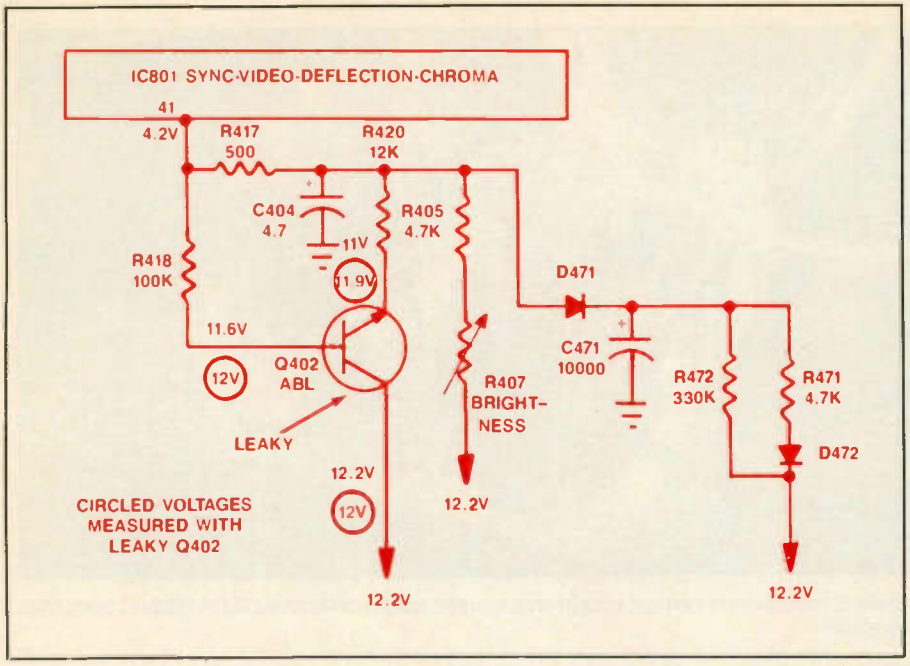

Figure 8. A leaky ABL brightness transistor (Q402) caused poor brightness in another 19J65 portable.

even turning up the brightness and screen control all the way did not give a bright enough picture. While my first thought was that the picture tube was defective, the picture tube tested normal and I measured 25.2KV at the anode connection with brightness and contrast turned down.

All of the picture tube voltages that I measured were in agreement with the values that were recorded on the schematic. Voltages at the video amp (Q401) were good. The video input signal was fairly normal at the base of Q401, but it was only 0.5Vpp at pin 40 of IC801. The voltage measurement at pin 41 was also quite low; 1.1V. At first I suspected that Q401 was open or leaky, but it tested normal in the circuit.

I took another look at the schematic and located the ABL transistor (Q402). Voltage measurements at all of the pins of Q402 were very close to each other. This was not necessarily an indication of a problem, because the schematic indicated that these voltages were fairly close (Figure 8). The voltage at the collector was 12V and at the emitter 11.9V. A quick in-circuit resistance test of Q402 indicated a direct short between emitter and collector. When I removed Q402 and tested it outside of the circuit, it appeared normal. When I replaced Q402 (2SC-1815Y) with a GE-62 universal replacement the brightness returned.

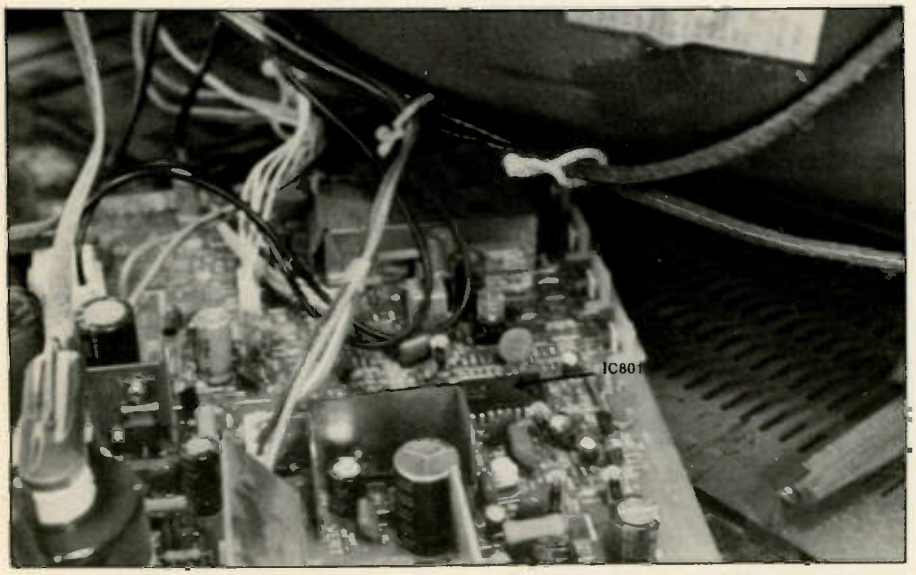

Figure 9. Large IC801 can cause many different circuits to fail. Here IC801 was replaced because the picture had no color.

Retrace lines - out of focus

This 19J65 chassis had some retrace lines in a poorly focused picture. This definitely had to be a case of a defective picture tube; except that the CRT tested good. Sometimes the focus control wanted to focus the screen, but usually had no effect. The focus should have a 2-3KV voltage change, except the voltage would not increase above 3.5KV.

The focus spark gap was cleaned out and the tube socket seemed to be normal. No doubt the focus assembly was defective. This meant that a new flyback transformer needed to be installed, since the screen and focus control assemblies are inside the flyback component (T602). Because of the cost of this repair, I prepared an estimate for the customer. After the estimate was approved, I replaced the flyback with an exact replacement; part number RTRNF0009PEZZ.

Intermittent color

The complaint on this set was intermittent color. When the chassis was opened up to work on it there was no color at all. The black and white picture was of good quality. I began to make DMM and oscilloscope checks. When I observed the signals at terminals 19, 20 and 21 of IC801 I saw nothing but noise. The color control had no effect on the picture.

Voltage measurements at the pins of IC801 were quite close to the specified values, except on pins 8, 19, 20, and 21. These were all about 4.5V low. I connected the oscilloscope to pin 16 to observe the output of the 3.58Khz oscillator. It was operating and producing the correct waveform. The supply voltage at pin 3 (12.2V) was normal.

When I sprayed coolant on IC801, color bars came into the black and white picture. Application of heat had no effect on the color picture. I concluded that the color section of IC801 was defective and therefore that the IC needed replacement (Figure 9). Replacement of IC801 with another ECG1547 universal IC replacement restored the color picture. ■

Digital electronics: A little logic goes a long way

By Lambert C. Huneault

In this era of digital electronics, logic can be serious business; but no one has ever said that we can't have a little fun while being "logical." So let's relax a bit, put our knowledge to the test, and enjoy another little game of logic; a sequel to "A game of logic from A to Z" published in the May, 1991 issue.

As in the first article, the object of the game is to find your way through a maze of logic gates and ICs. A basic knowledge and understanding of digital electronics, and a modest dose of logic, should enable readers to go a long way in this game; we hope all the way to the correct final answer.

The quiz

Before you're allowed to participate in this logic game, you must pay your dues. You do this by answering ten questions (Q through Z). Correct answers buy you the right chips to play the game (gamblers at heart will enjoy this.)

Huneault was an electronics instructor and head of the REE Department at St. Clair College of Applied Arts and Technology in Ontario, Canada and is now retired.

Answer each of the ten multiple-choice questions with either a 1 or a 0, depending on your choice. Your answers determine whether a HIGH (logic 1) or a LOW (logic 0) gets placed at the various input terminals of the circuit diagram in Figure 1. Use a *pencil*, keep an eraser handy, and simply label each input terminal (Q through Z) with a 1 or a 0, corresponding to your answers.

The logic maze

Then comes the fun part; i.e. figuring out how the fourteen digital devices (gates, integrated circuits and LED readout) respond to the input logic. Follow the action throughout the circuitry, writing down the resulting logic level (1 or 0) at each input and output.

After working your way through the maze, determine the output number displayed by the seven-segment readout. Commit yourself by *writing it down* in the space provided in Figure 1, *before* sneaking a peek at the all-revealing Figure 7. The correct answer will be your payoff.

Here are a few comments concerning Figure 1:

- MSB and LSB stand for *most significant bit* and *least significant bit*, respectively.
- LTI in IC2 indicates the *lamp test input* which can be used to cause all segments of the display to light up simultaneously.

So let's go and give it a whirl - take the quiz, earn your chips and play the game right now. Some informative explanations will be given along with the answers, following the quiz.

Ten questions

Q. A 16-line address bus can access:
0 - 64000 different memory addresses
1 - 65536 different memory addresses

R. A type 555 IC is a:
0 - decoder
1 - timer

S. In Boolean algebra, "V.Z" means:
0 - V AND Z
1 - V OR Z

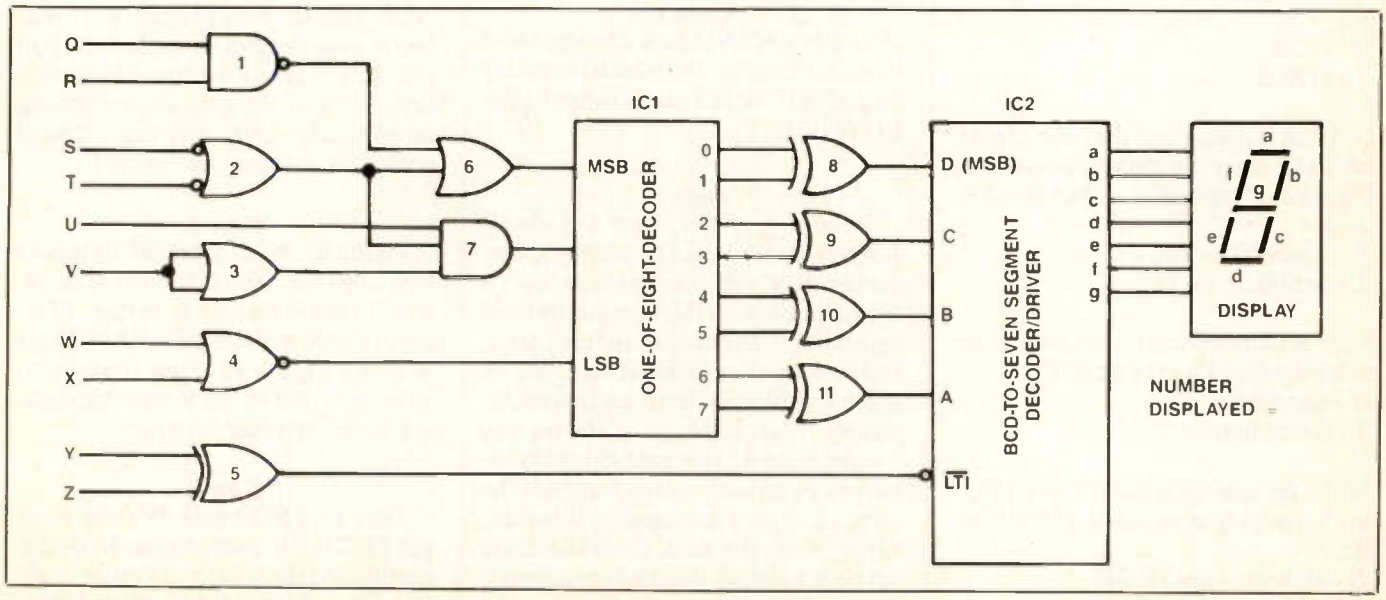

Figure 1

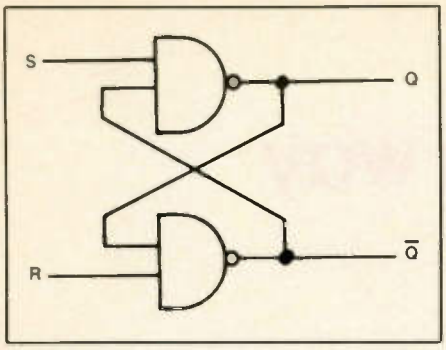

Figure 2

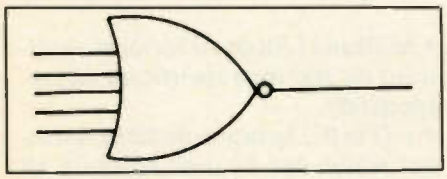
Figure 3

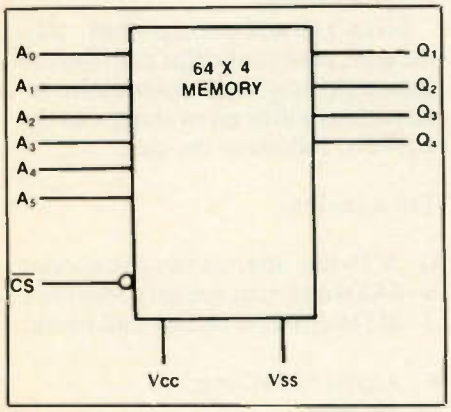

Figure 4

T. A logic HIGH is present at both J and K inputs of a J-K flip- flop, and its Q output is LOW to begin with. After one clock pulse, output Q will be:
0 - LOW
1 - HIGH

U. What is the state of the NAND gate latch (set-reset flip-flop) illustrated in Figure 2, if input S = 1 and input R = 0:
0 - Reset (Q = 0)
1 - Set (Q = 1)

V. Is a BCD counter a sequential or combinational logic circuit?
0 - Sequential
1 - Combinational

W. In the multiple-input gate of Figure 3, the output terminal goes HIGH if:
0 - all inputs are HIGH
1 - all inputs are LOW

X. A microprocessor is said to be an eight-bit device when:
0 - its data bus contains 8 lines
1 - its address bus contains 8 lines

Y. The IC shown in Figure 4 is a:
0 - ROM
1 - RAM

Z. In a three-state logic circuit, the third state (i.e. the state other than HIGH or LOW) is referred to as:
0 - limbo
1 - high impedance

Answers and explanations

The answers to the ten questions are shown in Figure 7, in the form of 1s and 0s at the ten inputs, Q through Z. Few answers require an explanation, but the following notes may be useful to people who are less familiar with logic terminology and operation:

- Question T: With both J and K inputs HIGH, a J-K flip-flop is in the *toggle* mode, i.e. its output toggles (changes state) with each clock pulse.
- Question W: Figure 3 is a NOR gate; the output of a NOR gate goes LOW if any of its inputs is HIGH; therefore all inputs must be LOW in order to force the output HIGH.
- Question Y: The IC shown is a ROM, because it doesn't feature a read/write line and data *input* lines necessary in a RAM.

Figure 7 is a duplicate of Figure 1, but with the correct logic state shown on each line. Following is a gate by gate analysis.

Gate 1

Gate 1 is a NAND gate (the opposite of an AND gate). With both inputs (Q and R) HIGH, the gate's output goes LOW (logic 0).

Gate 2

Believe it or not, gate 2 is also a NAND gate (in the OR format). Unfortunately, some technicians have a little trouble with this commonly used symbology. My answer to this potential source of confusion is very simple: since bubbles indicate an inversion, simply invert the logic at the inputs, i.e. the 0 outside the gate (S input) becomes a 1 inside; and the 1 outside the gate (T input) becomes a 0 inside. Once inside the gate, these two logic levels are simply handled (processed) by the OR gate function indicated by the symbol. Therefore the 1 and 0 that have entered this "OR" gate result in a 1 at the output.

INPUTS		OUTPUT
S	T	
0	0	1
0	1	1
1	0	1
1	1	0

Figure 5

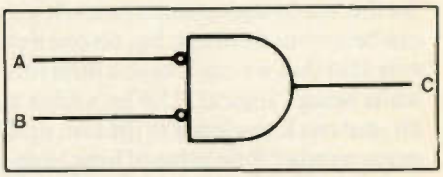

Figure 6

It's that simple. Don't let these "funny-looking" logic symbols intimidate you. If you have difficulty accepting that gate 2 is a NAND gate, then don't think of it as a NAND gate; instead, just invert the inputs (as indicated by the bubbles) and then think of it as an OR gate (as suggested by the symbol). Life is a lot easier that way. And if you're still not convinced, take a look at Figure 5, the truth table for a NAND gate. Try inverting the inputs and processing the inverted logic as if you were dealing with a simple OR gate. You'll see that the outputs remain as indicated for each of the four possible input combinations.

The same thinking applies to another frequently encountered format: the NOR gate shown in Figure 6. If that NOR gate symbol doesn't turn you on, simply invert the input logic and then think of the gate as performing an ordinary AND function. You'll come out a winner each time!

Gate 3

Gate 3 is a NOR gate with its inputs tied together. Thus connected, it always behaves as an inverter. (The same would be true for a NAND gate with its inputs shorted together). Therefore the 0 at the V input becomes a 1 at the inverter's output.

Gate 4

Gate 4 is a NOR gate. With its W input HIGH, its output goes LOW regardless of the logic at its other input (X). If you have trouble remembering

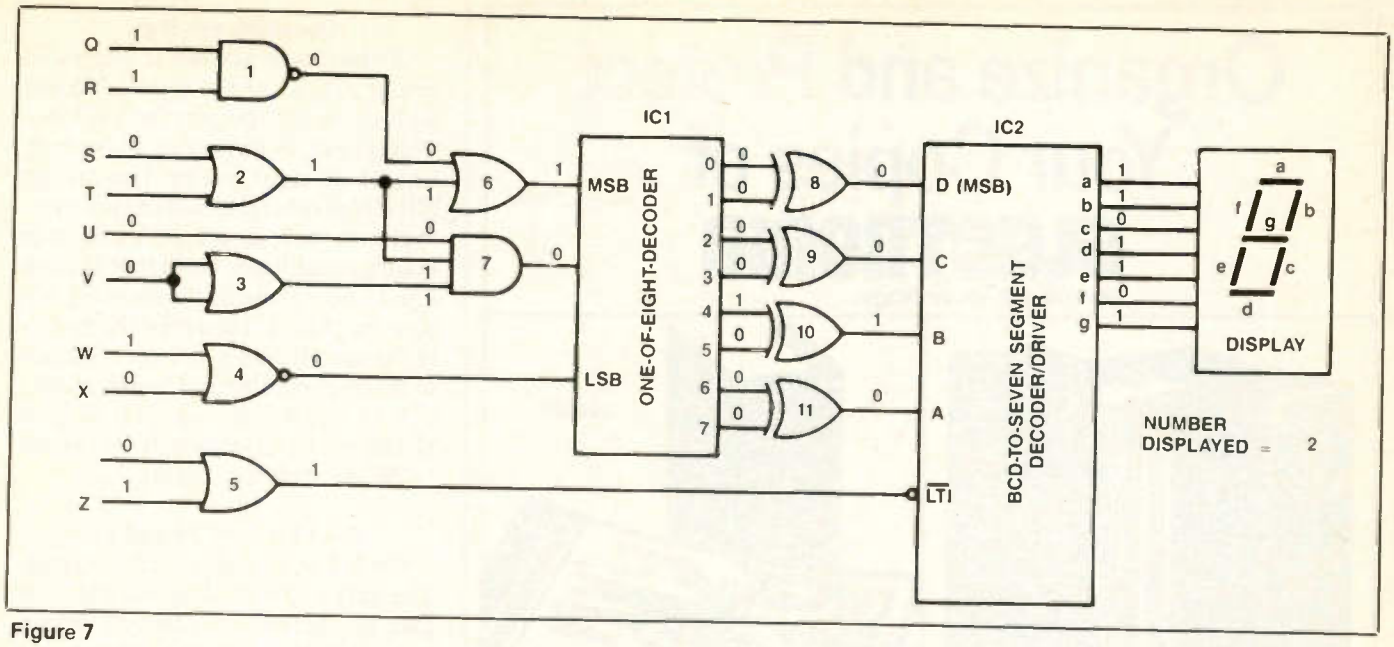

Figure 7

the truth table of a NOR gate, simply think of it as an OR gate, and then invert its output, as suggested by the bubble at the output terminal; it works every time!

Gate 5

Gate 5 is an EXCLUSIVE OR gate (XOR). The main characteristic to remember about an XOR gate is that its output goes HIGH only when its inputs are *different*. In Figure 5, the Y and Z inputs are indeed different (0 and 1), therefore gate 5's output is a 1.

Gate 6

Gate 6 is a straightforward OR gate, whose 0 and 1 inputs result in a 1 output.

Gate 7

Gate 7 is a triple-input AND gate. With a logic 0 at one of its inputs (U), its output obviously goes LOW.

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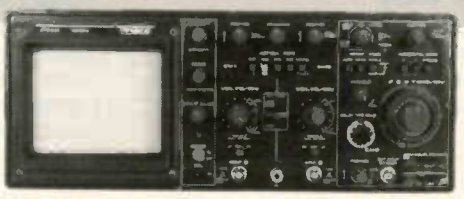

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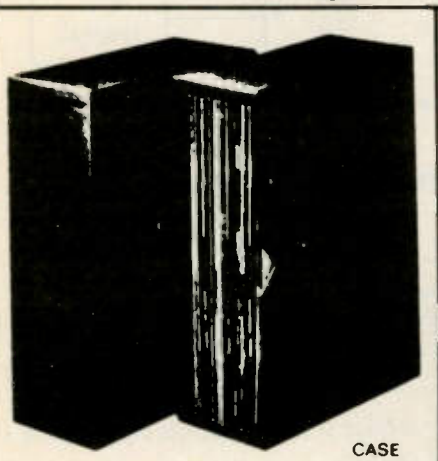

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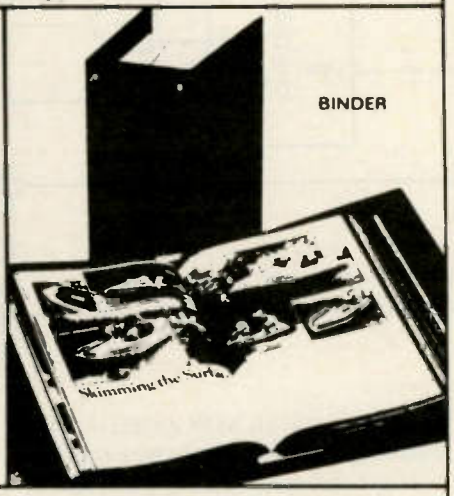

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Decoding the logic

We have now arrived at integrated circuit IC1, a "one of eight" decoder with active-high outputs (no bubbles). This type of digital circuit allows only one of its eight output lines to go HIGH (all others remain LOW), in response to the logic present on its three binary input lines. Note that the top input line represents the most significant bit (MSB); therefore the binary input word is 100, which corresponds to decimal number 4. Consequently, output line 4 is activated (i.e. goes HIGH) while all other outputs remain LOW, as shown in Figure 7.

GATES 8, 9, 10 and 11

Gates 8, 9, 10 and 11 are XOR gates. The only one with *different* inputs is gate 10; therefore the latter's output goes HIGH while the other three gates' outputs remain LOW.

This takes us to IC2, a BCD-TO-SEVEN-SEGMENT DECODER/DRIVER with active-high outputs (no bubbles) which drive the seven segments of the digital readout, causing the final answer to be displayed. Which number is it going to be?

Well, look at the DCBA input word supplied by the four XOR gates: D being the MSB, the decoder's input is therefore number 0010, equivalent to decimal number 2. This causes the a, b, d, e and g outputs of the decoder/driver to be activated (i.e. go HIGH), while c and f remain LOW. The HIGH outputs cause the corresponding segments to light up, displaying the numeral 2.

Post-game remarks

Had you figured it out right? If 2 was your answer, congratulations, you've won the game!

Incidentally, if you answered questions Y and Z incorrectly, or made a mistake in figuring out the output of XOR gate 5, you would have ended up with a LOW logic level (instead of a logic 1) at the lamp test input of IC2. As indicated by the bubble as well as by the overbar above the letters LTI, this is an ACTIVE-LOW input. Therefore the LOW logic level would have activated the lamp test, causing all seven output lines to go HIGH and lighting up all seven segments of the readout. Thus the numeral 8 would have been displayed.- That's all for now. We hope you enjoyed the game and possibly learned a little from it.

Programmable power supplies

By the ES&T Staff

Adapted with permission from the booklet "Q's & A's About Programmable Power Supplies," published by American Reliance.

A programmable power supply is a power supply, programmer and voltage/current meter in one instrument (see Figure 1). It provides greater accuracy in setting voltage and current output values, and even allows a user to compensate for the voltage drop across the leads from the supply output to the load. A programmable power supply also needs less maintenance and provides many time saving features.

This type of power supply has been around for a long time, but only recently, because of advances in integrated circuit technology, has it become inexpensive enough and easy enough to use that it would even be conceivable to use in anything other than a research and development lab, or other organization with deep pockets. It is still almost certainly not for every service center, but consumer electronics servicing technicians should at least be aware that they exist.

Because these supplies may be controlled by either of two methods, they are useful in a variety of environments. For instance, in a lab or service center, setting or modifying the supply's output is done by simple keypad operations. Or in an ATE (automated test equipment) environment, outputs may be controlled by GPIB software commands sent from the computer via a GPIB bus (IEEE-488 bus).

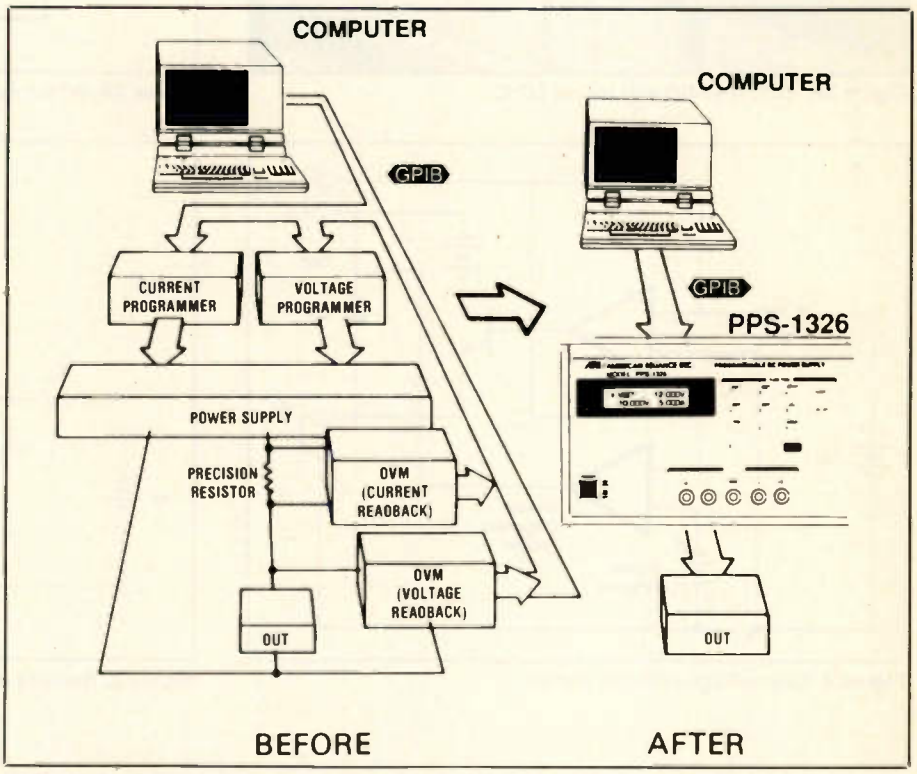


Figure 1. Programmable power supply with built-in voltage/current programmer and voltage/current meter.

Programmable power supply vs linear power supply

Programmable power supplies are as easy to operate as linear power supplies, yet they provide superior features and benefits. For instance, entering a voltage and/or current value through the front panel of a programmable supply is more accurate than adjusting a linear power supply's fine tune knob (see Figure 2). In addition, the remote sensing function compensates for any voltage drop caused by load leads by sensing voltage at the actual load.

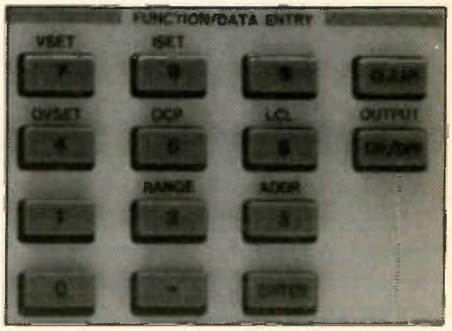


Figure 2. Front panel function/data entry keypad.

One of the most time saving and useful functions of a programmable power supply is its ability to be software calibrated. This function is applicable either through the front panel or via GPIB remote operation. The benefits of just this one feature are: one less system downtime, since units do not have to be removed or opened to perform this operation. And two, reduced maintenance cost since all calibration is performed in house. What this all leads to is an increase in savings, profits and time.

The computer interface

Most programmable power supplies may be interfaced directly with a computer. Depending upon the manufacturer, the interface may be standard equipment, or it may be an additional-cost option. A typical interface is a GPIB (general purpose interface bus) that conforms to IEEE-488 standard (IEEE is the Institute of Electrical and Electronic

Figure 3A. Full, load burn-in test at 50°C.

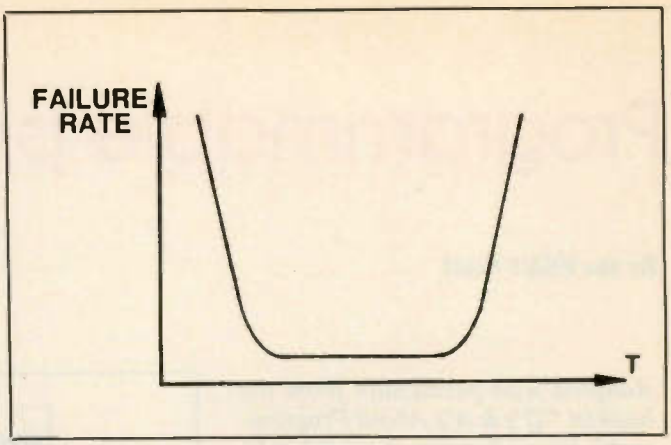


Figure 3B. Infant mortality bell curve.

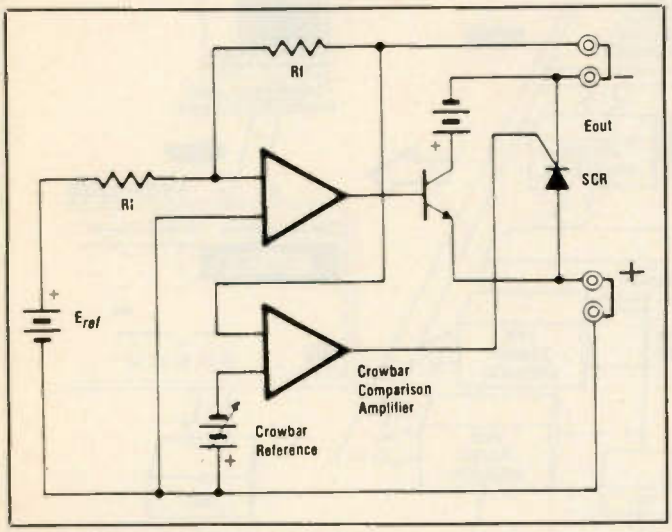


Figure 4. Overvoltage crowbar circuit.

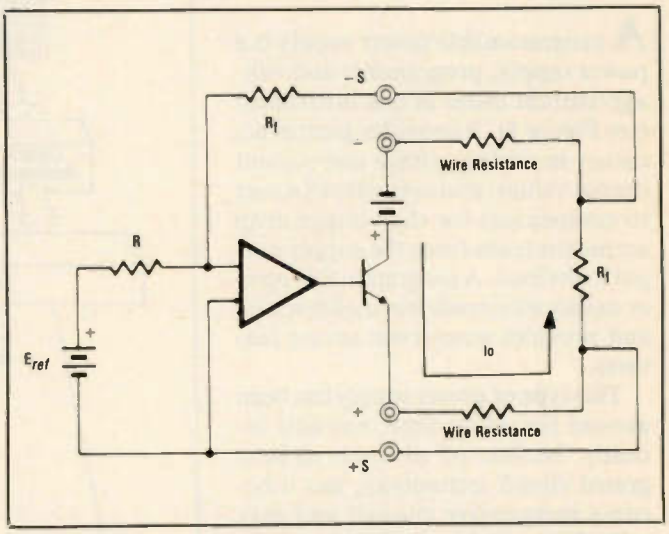


Figure 5. Remote error sensing circuit for voltage stabilization

Engineers) and is able to both talk and listen.

Crowbar protection

An important feature on any power supply is overvoltage protection circuitry on the output. This feature protects a system, especially a sensitive one from dangerous power levels that may destroy it.

A crowbar circuit is considered an important feature, because when a series transistor fails the output of a power supply usually becomes a short circuit rather than an open circuit. This causes output voltage to attain full rectified value, and the current limit deactivates because it relies on the series regulating transistor. Also, since load current only limits load resistance, a transistor failure allows a dangerously high current output to the load. This can be an expensive failure in a complex logic circuit system where most TTL circuits operate at 5V to 7V.

Figure 4 illustrates a typical circuit employed to protect the power supply from overvoltage: an overvoltage "crowbar" circuit. In its simplest form, the crowbar circuit has a voltage comparator coupled to an SCR. This comparator continuously monitors the output voltage against a set reference voltage. If the output exceeds the reference voltage, the comparator allows the SCR to fire and short circuit the output.

A further enhancement to the crowbar is a built in circuit to shut down the power supply after an SCR fires. The need for this is especially true of high current supplies where short circuit current may destroy the crowbar due to high temperatures.

Remote sensing

The purpose of measuring voltage at the load instead of the terminals of the power supply terminals is to preserve load regulation and compensate

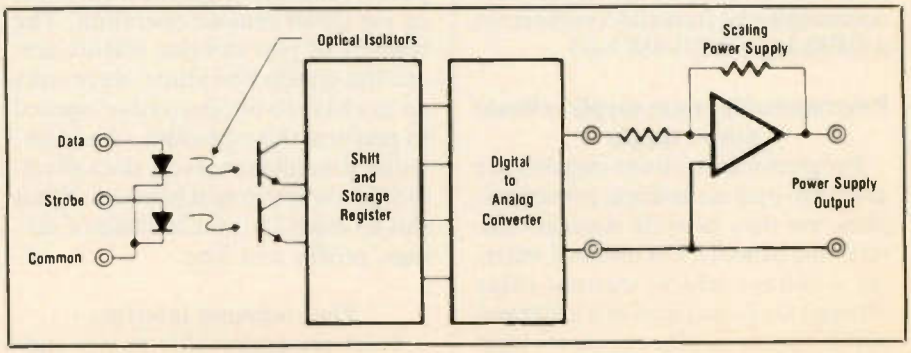


Figure 6. Optocoupler isolation circuit.

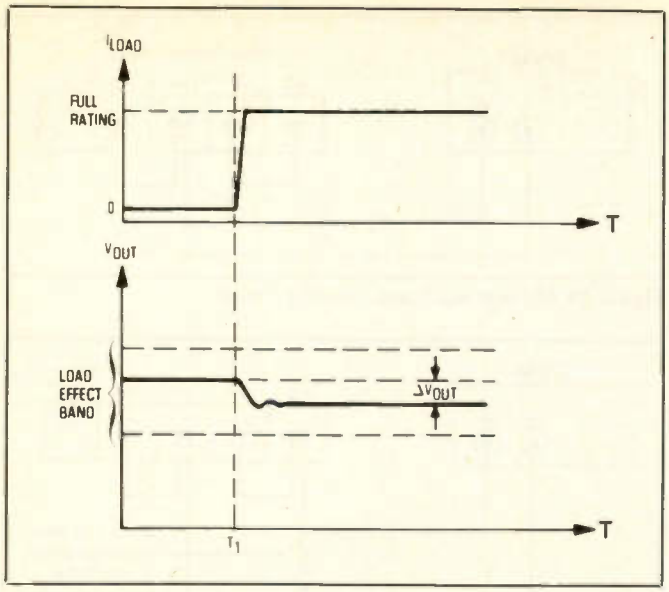


Figure 7. Load effect variation in CV mode.

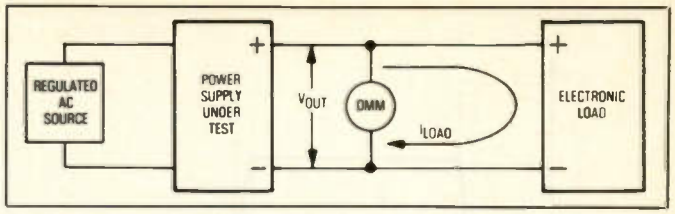


Figure 8. Load effect trest configuration in CV mode.

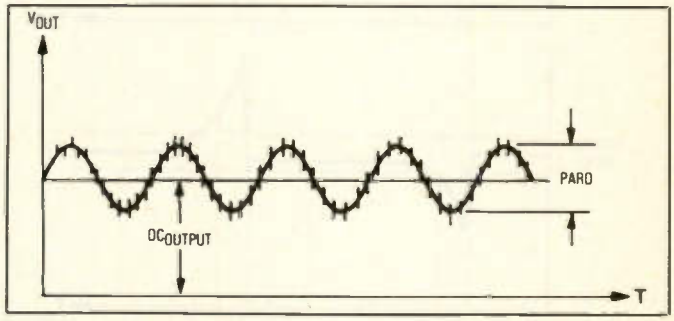


Figure 9. Undesirable PARD superimposes on dc output.

for any voltage drops in the leads. These remote sense leads carry very low current and, when possible, should be twisted and shielded to prevent noise pickup by the regulation circuit of the power supply.

Remote sensing improves voltage stabilization by a 4-wire Kelvin connection between power supply and load. Figure 5 Illustrates the use of remote error sensing for voltage stabilization. In this configuration, one pair carries the load current while a second pair senses output voltage without any load current.

Some programmable power supplies are designed to be capable of delivering a higher voltage than the rated voltage so that they can sustain a voltage drop across the wire connecting the power supply to the load and still deliver the rated voltage to the load.

Optocouplers in a programmable power supply

An optocoupler is a means of providing complete electrical isolation between two parts of an electronic product; the signal is passed from one to the other via a beam of light. In a programmable power supply, the optocoupler (optical coupler) is a means to isolate the digital portion of the circuit from the analog portion. This allows the output to be grounded or floated at will. Moreover, optocoupler isolation improves common noise interference between two circuits. Figure 6 is a simplified diagram of optocoupler isolation.

The importance of "load effect"

Load is an important parameter in power supplies because it's important to provide a stable, constant output when the load being supplied is sensitive to supply voltage deviations. Load effect, or load regulation, is a practical test to determine if a power supply remains within defined output limits for a variation in load.

A power supply may operate in CC (constant current) mode, CV (constant voltage) mode, or some can work in both. In the case where a power supply works in both modes, there are load effects for voltage and current. For instance, in the CV mode, the power supply would have steady output current as the regulating parameter. Conversely, in the CC mode

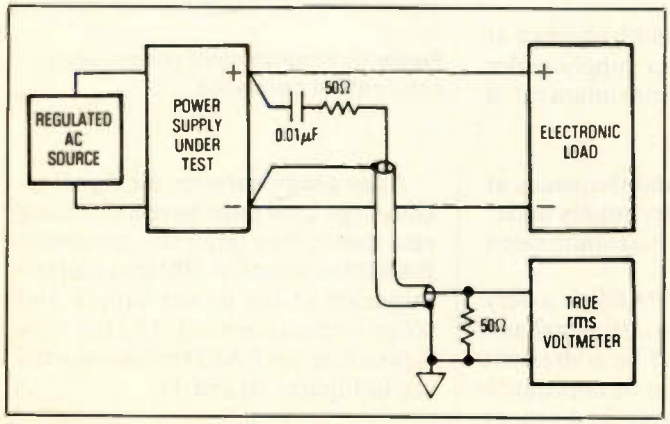


Figure 10. "RMS" PARD measurement.

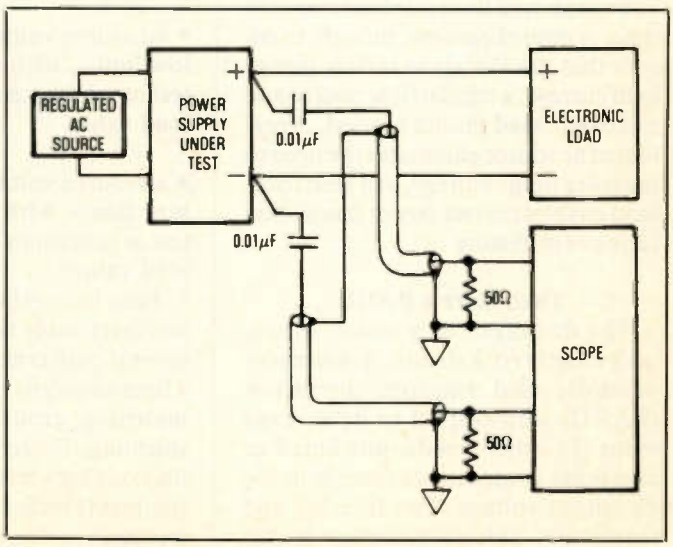


Figure 11. "Peak-to-peak PARD measurement.

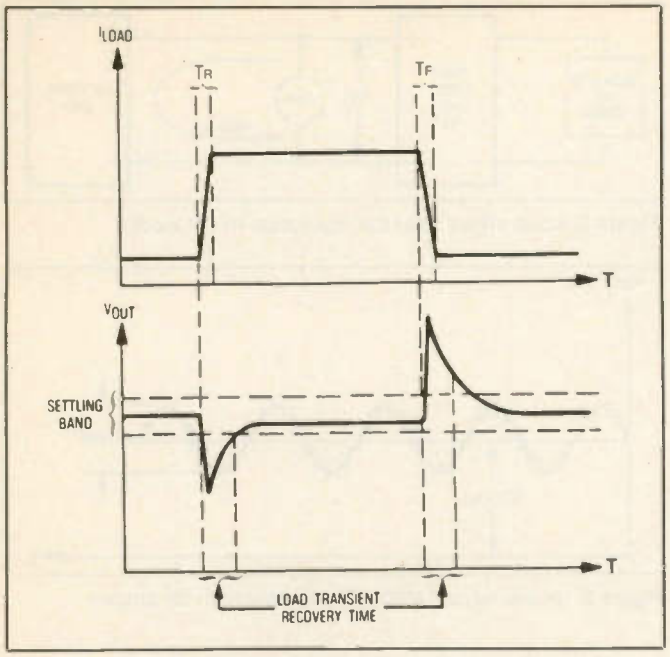


Figure 12. Load transient recovery time for voltage current

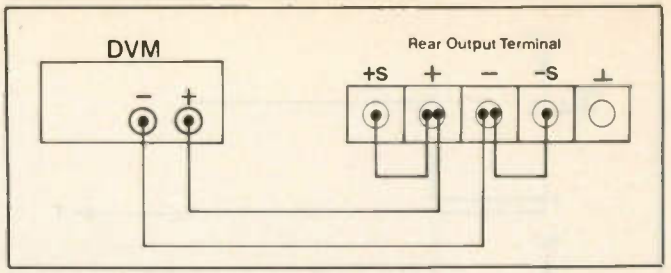


Figure 13. Voltage calibration configuration

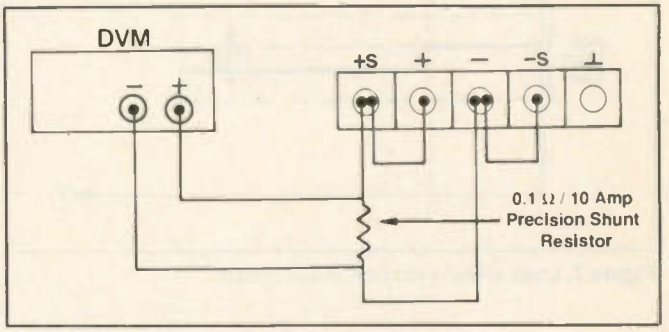


Figure 14. Current calibration configuration

the power supply would have steady output voltage as the regulating parameter.

Typical load effect values run at 0.02% to 0.1%, of full rated values for linear power supplies. A dependable practice is to plot variation of current and voltage versus time to note load effect variation. Figure 7 illustrates how a change in current determines a change in voltage for CV mode.

Measuring load effect

Figure 8 gives a test configuration for measuring the load effect for CV mode. The output voltage should be measured before and after the load has been varied from minimum to maximum current rated value. This output voltage should have adequate settling time. A note of caution, though: to ensure that the variation is only due to load current, a regulated ac source and electronic load should be used. A regulated ac source eliminates the need to measure input voltage. An electronic load enables correct power dissipation ratings for testing.

Then there's PARD

The dc output of a power supply isn't exactly rock steady; it undergoes periodic and random deviation (PARD) with respect to its average value. In other words, unwanted ac and noise components remain in the dc output voltage after filtering and regulation. This phenomenon is also called ripple and noise.

PARD is specified in two ways to distinguish two different occurrences: rms and peak to peak. The rms value assists in deciding signal-to-noise ratio. Peak-to-peak assists in obtaining facts on short duration noise spikes of high magnitude.

Test conditions specify a limited bandwidth (20Hz to 20MHz) with all other parameters constant. Figure 9 illustrates how undesirable PARD is superimposed on the dc output.

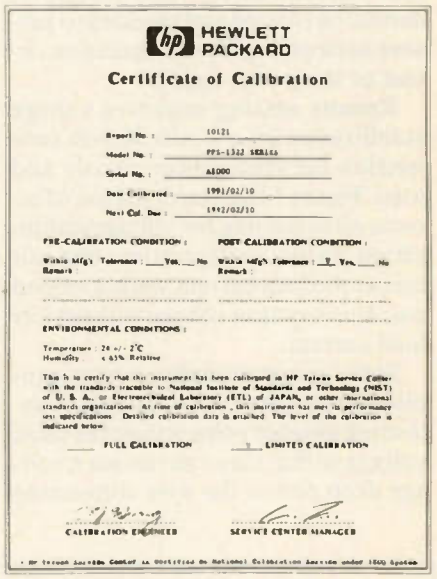
Featuring PARD

A measurement of PARD is taken for both rms and peak-to-peak values. These tests are performed at the following points:

- ac source voltage and frequency at low limits, with power supply under test at minimum and maximum rated load value

- ac source voltage and frequency at high limits, with power supply under test at minimum and maximum rated load value.

Bear in mind that PARD is a very low level, wide bandwidth signal and several concerns must be addressed. These concerns consist of impedance matching, ground loops, and proper shielding. Therefore appropriate connections between power supply and instruments under test are essential for testing.



HEWLETT PACKARD

Certificate of Calibration

Report No. : 10121
Model No. : PPS-1322 SERIES
Serial No. : A8000
Date Calibrated : 1991/02/10
Next Cal. Due : 1992/02/10

PRE-CALIBRATION CONDITION : POST CALIBRATION CONDITION :
Within Mfg's Tolerance : ___Yes. ___No Within Mfg's Tolerance : _X_ Yes. ___ No
Remark Remark

ENVIRONMENTAL CONDITIONS :
Temperature : 24 +/- 2°C
Humidity : < 65% Relative

This is to certify that this instrument has been calibrated at HP Taiwan Service Center with the standards traceable to National Institute of Standards and Technology (NIST) of U. S. A., or Electrotechnical Laboratory (ETL) of JAPAN, or other international standards organizations. At time of calibration, this instrument has met its performance test specifications. Detailed calibration data is attached. The level of the calibration is indicated below.

___ FULL CALIBRATION _X_ LIMITED CALIBRATION

CALIBRATION ENGINEER SERVICE CENTER MANAGER

Figure 15. Programmable power supply certificate of calibration.

As an additional note, the digital oscilloscope used must have a digitizing rate that is five times the maximum PARD frequency. A 50Ω (coaxial) termination at the power supply and scope is recommended. The test configurations for PARD measurements are in Figures 10 and 11.

Load transient recovery time

When a step change is made in the current or voltage of a power supply, it takes a certain amount of time for

(continued on page 37)

ES&T Manufacturers' schematics **PROFAX**

FEBRUARY 1992

Profax Number

Hitachi
AP13 Color TV.....3085

BASIC CIRCUIT DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characterIstics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

ES&T Manufacturers' schematics **PROFAX** 3085

BASIC CIRCUIT DIAGRAM

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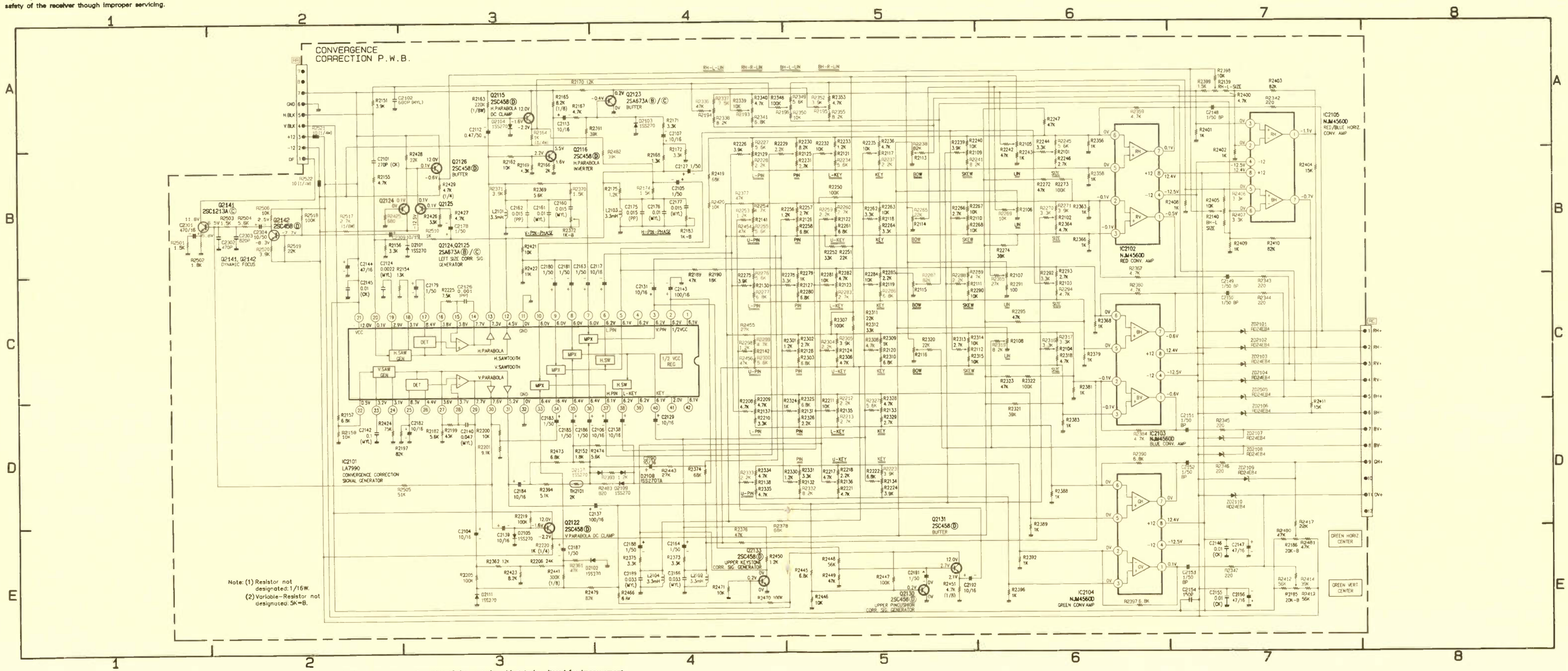
This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.

PRODUCT SAFETY NOTE: Components marked with a ⚠ and shaded have special characteristics important to safety. Before replacing any of these components, read carefully the PRODUCT SAFETY NOTICE of this Service Manual. Don't degrade the safety of the receiver though improper servicing.



- Since this is a basic circuit diagram, the value of the parts is subject to be altered for improvement.
- All DC voltage to be measured with a tester (100kΩ/V). Voltage taken on a complex color bar signal including a standard color bar signal.

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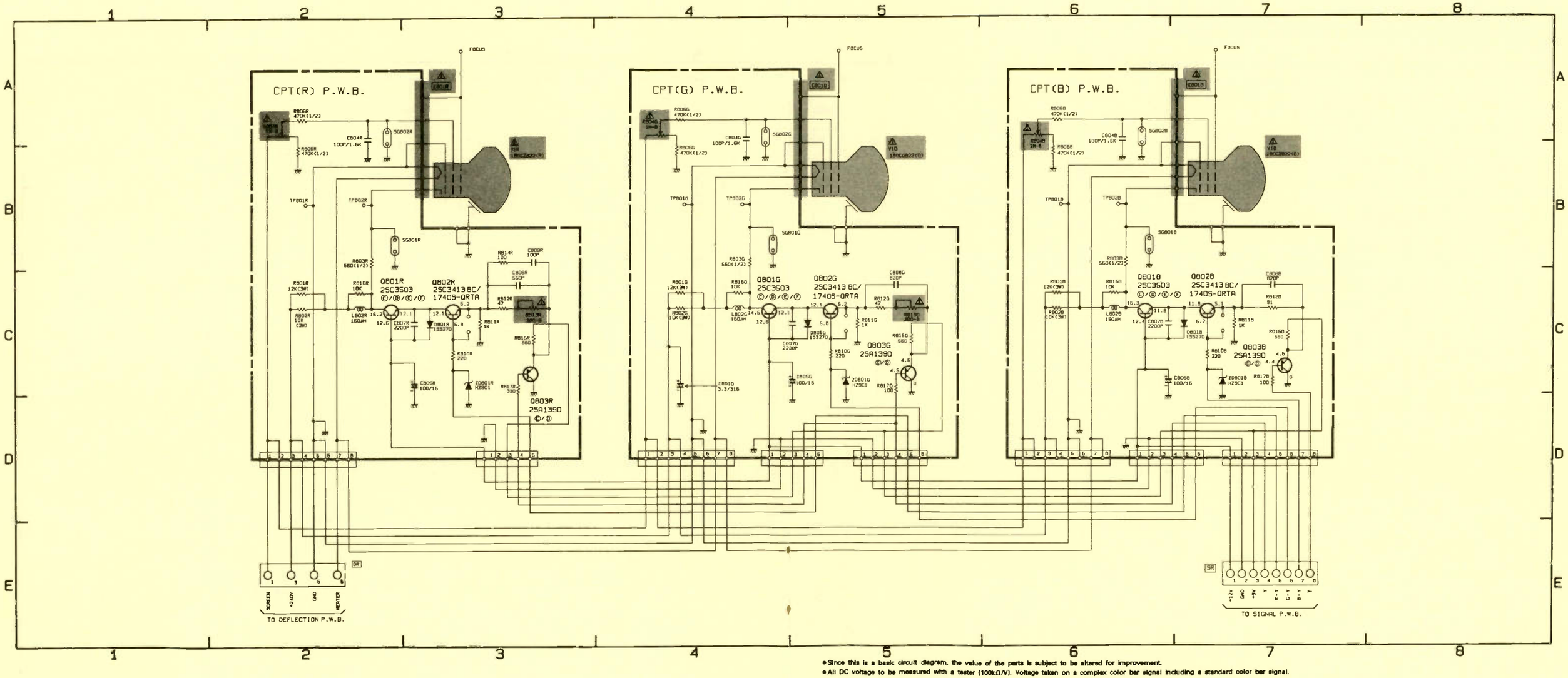

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Manufacturers schematics PROFAX 3085

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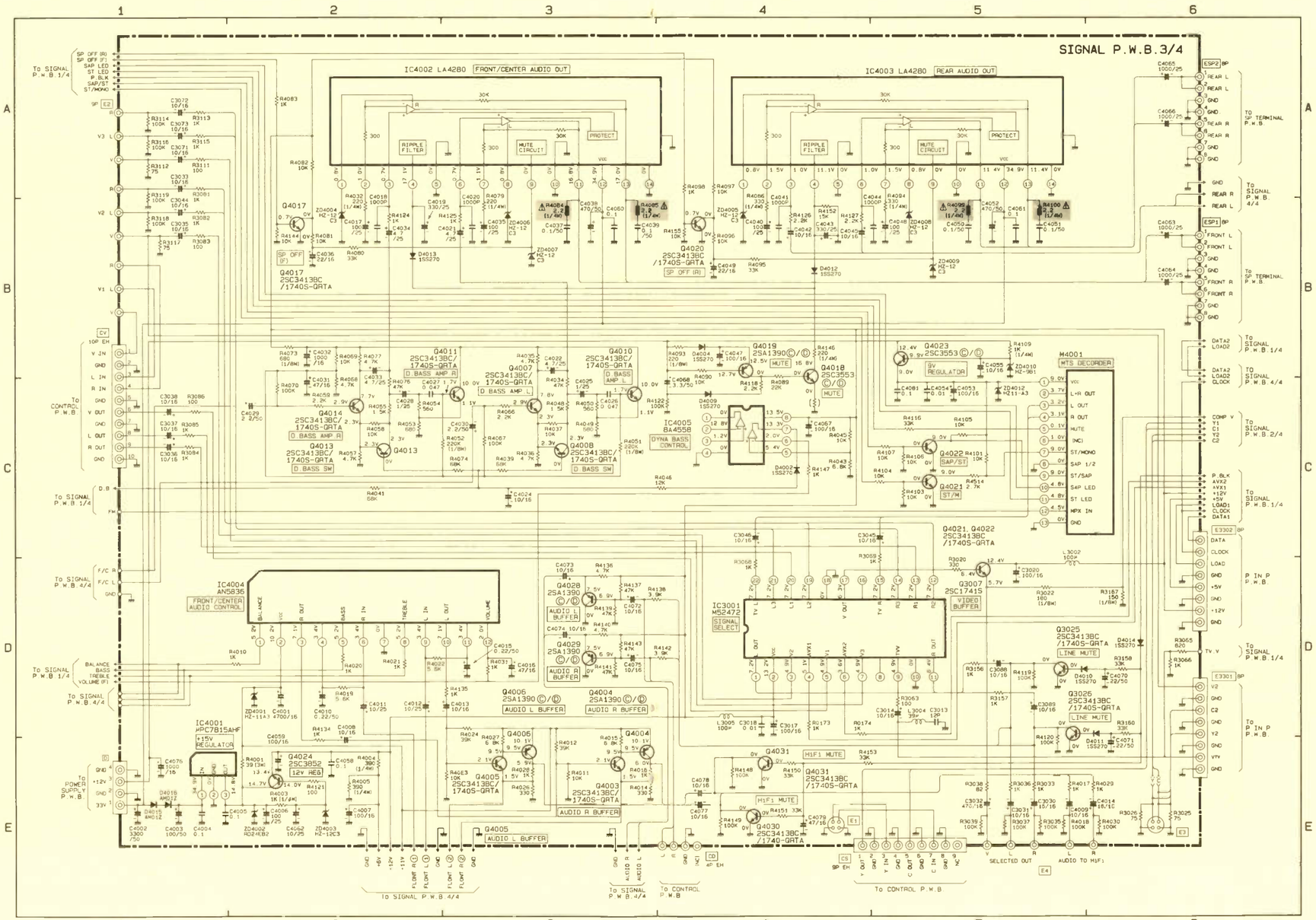

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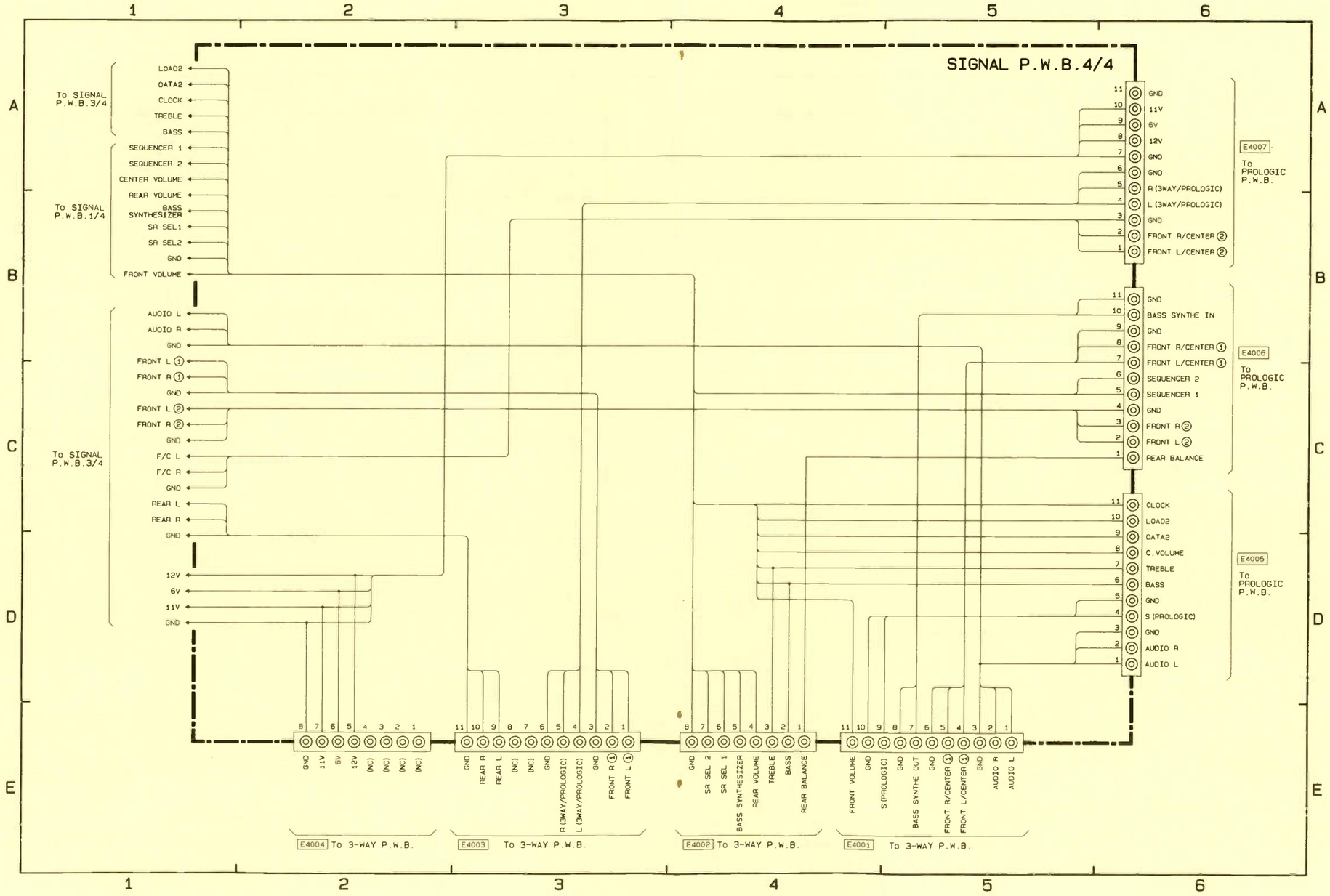

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American Reliance Inc.

Programmable Power Supply Calibration Report

MODEL: PPS-1322 ID: 91130000

Calibration Factors:
Channel 1: Voff= 0.468 Vfs= 27.898 Ioff= 0.042 Ifs= 1.976

Voltage Vset	Vset	Vrb	Vm	dVset	dVrb	dVst	dVrt
	1.500	1.492	1.497	2.0	-6.0	8.0	11.0
	3.300	3.293	3.295	4.0	-3.0	9.0	13.0
	5.000	4.989	5.001	-1.0	-12.0	10.0	15.0
	9.000	8.990	9.000	0.0	-10.0	12.0	19.0
	12.000	11.992	11.999	1.0	-7.0	14.0	22.0
	15.000	14.993	14.999	1.0	-6.0	15.0	25.0
	18.000	17.994	17.999	0.0	-6.0	17.0	28.0
	24.000	23.997	23.999	0.0	-3.0	20.0	34.0
	28.000	27.989	27.996	3.0	-7.0	22.0	38.0
	32.000	31.990	31.992	7.0	-3.0	24.0	42.0
Current	**Iset**	**Irb**	**Im**	**dIset**	**dIrb**	**dIst**	**dIrt**
	0.100	0.100	0.100	-1.0	-1.0	3.0	3.0
	0.200	0.200	0.200	0.0	0.0	3.0	3.0
	0.500	0.500	0.500	0.0	-1.0	3.0	4.0
	0.800	0.800	0.800	-1.0	-1.0	4.0	4.0
	1.000	1.000	1.000	-1.0	-1.0	4.0	5.0
	1.200	1.199	1.200	0.0	-1.0	4.0	5.0
	1.400	1.399	1.400	0.0	-1.0	5.0	5.0
	1.600	1.600	1.600	-1.0	-1.0	5.0	6.0
	1.800	1.799	1.800	-1.0	-2.0	5.0	6.0
	2.000	1.999	2.001	-1.0	-3.0	6.0	7.0

Note:
1. DVM: HP-3478A
2. Current shunt: PRC PLV-5, 0.1 ±0.05%
3. Vset, Iset: Value setting
   Vrb, Irb: Readback value
   Vm, Im: Value measured on DMM
   dVset, dIset: Setting tolerance measured in mV and mA.
   dVrb, dIrb: Readback tolerance measured in mV and mA.
   dVst: Voltage setting tolerance = setting x 0.05% + 8mV
   dVrt: Voltage readback tolerance = setting x 0.1% + 10mV
   dIst: Current setting tolerance = setting x 0.15% + 3mA
   dIrt: Current readback tolerance = setting x 0.2% + 3mA

Figure 16. Programmable power supply calibration report.

the output voltage of the supply to settle to within specified output accuracy limits. The value of this "load transient recovery time is typically measured in microseconds or milliseconds depending on the power supply. Figure 12 consists of voltage output versus time and current load versus time, which illustrate measurement of load transient recovery time.

Another example of constant, rapid technological change

The availability of programmable power supplies for the service center environment is another evidence of the incessant, rapid change in the technology that service centers, and society in general, are encountering. Just a few years facsimile was too expensive and required too specialized training to operate, now fax is accessible to almost everyone. Answering machines have gone from being a curiosity to being a necessity. And it seems as though every other car on the road has a cellular telephone in it.

The programmable power supply may not be for everyone, but for those who have use for them, they're readily available. ■

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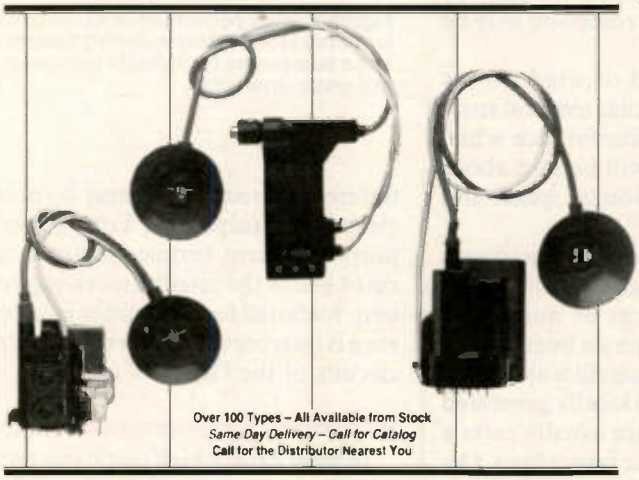

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Curing satellite system electrical interference and interruptions

By Francis J. Stifter

Spikes, surges, noise, interference and interruptions have disrupted satellite reception since the earliest dishes were installed. Early system viewers learned to accept interference and interruption. Poor overall satellite system performance was the accepted standard. Viewers with little viewing experience were pleased to receive any reception at all. Interference and interruptions were considered a natural part of satellite viewing.

Modern satellite systems are much more predictable. Modern viewers expect interference free entertainment. Unfortunately, present day systems are more complex than earlier equipment, making them more vulnerable to disturbance and interference.

Power-related problems

Frequent memory loss requiring reprogramming may not be due to poor receiver design. Often ac power line interference is the culprit. Some on-site refrigerator, furnace or pump motor most likely is creating enough interference to disrupt the memory. Occasionally lightning or atmospheric discharges disrupt memory.

A satellite system had major repair some time ago, but it seems an IRD component fails every few weeks. Unlucky? Probably not. AC power line spikes from motors or other electrical equipment may be slowly degrading the IRD.

Reception had been fine all during the snow storm; suddenly the dish failed to respond to positioning commands. Normal wear out? More likely electrical discharges accompanying the snow storm caused sensor or motor damage. Not as spectacular (or damaging) as summer, damaging electrical discharges are often generated by snow, sand or wind storms.

Stifter is President, of Electronic Specialities, Inc.

Interference and interruptions

Modern satellite receivers employ microcomputer chips throughout for amplifying, detecting and decoding received signals. Like computers, these chips operate on low level voltages and signals. Relatively low level interference will often cause momentary lapses from normal operation.

Manmade and atmospheric electrical noise (interference) can enter the satellite system through signal or power lines, causing performance deterioration or viewing interruption.

Interference induced erratic behavior may include momentary picture flicker or sound burst. In more severe situations a frame may jump, memory may de-program or reception may be interrupted.

Snow, rain, sand or wind storms can generate significant eletrical energy which creates interference when discharged. More will be said about this in the next section on spikes and surges.

Electrical equipment such as pump motors, electric fence controllers, refrigerators, furnaces or automatic regulators often generate interference that interacts with satellite systems.

Atmospheric and locally generated electrical interference usually enter a system through the ac power lines. Occasionally local or atmospheric interference may be picked up by signal or control cables. This for example, could develop if a long electrical cable powering an electrically noisy machine runs close to dish cabling.

IRD or TV circuits may pick up interference directly from near-by noisy electrical equipment. For example noisy basement furnace motor is located below the satellite receiving system. Radiated furnace motor interference is intercepted by internal printed circuits of the IRD, TV or VCR.

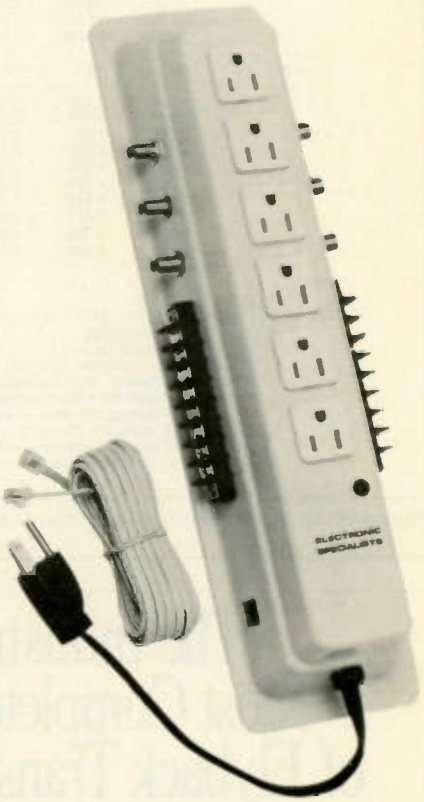

Figure 1. High performance AC power filter/supressor, unit includes high capacity spike supressors for satellite receiver control and signal linee.

Interference and interruption control

In most cases a high quality ac power filter for the entire receiving system will provide sufficient noise elimination to prevent memory scrambling. Improved picture and sound quality is usually noticed when ac power filters are used.

Figure 1 shows a specially designed

unit with sockets to accommodate various components of the receiving system. This unit has wide band filtering spike and surge suppression (more on spikes and surges later) for total ac power protection. Simple, low cost spike supressors do not provide the filtering necessary for adequate interference control and often provide only moderate spike/surge suppression. Signal and control line protection are also included on the model shown.

Noisy machinery at the end of long electrical cables, given as an example above, usually requires a wire-in electrical filter installed at the noisy machine. Check machine frame grounding; install a good ground if none exists.

If good grounding and a filter do not sufficiently reduce interference, it may be necessary to run the ac electrical lines through a condult. Condult grounding at only one end usually provides the best interference elimination.

Let's look at an interference cure for the second example above a noisy furnace motor radiating directly into receiving equipment. Again, a wire-in filter and motor frame grounding usually eliminates interference. Additional interference reduction can be achieved by routing the ac through a condult grounded at one end.

Should interference problems remain after these measures, consider installing an electrostatic shield between furnace and receiving equipment. A 3'x 3' copper screen positioned between noise making motor and receiver would reduce interference considerably. Tack the screen to the basement ceiling. Attach a ground to the screen.

Spikes and surges

As mentioned earlier, electrical energy is generated by snow, rain, wind, and sand storms. This energy usually discharges in bursts, creating electromagnetic fields which radiate across the countryside.

A comparison can be made to the static electricity you generate when walking across a carpet. Upon touching a door knob, you receive a jolt which discharges the eletrical energy your body had accumulated.

This electrostatic discharge (ESD) occurred because your body had stored a potential by simply walking across that carpet! Although ESD is different atmospheric discharges, an illustrative comparison can be made to see that moving bodies can store tremendous voltages.

When atmospheric stored electrical energy reaches a critical voltage, it discharges to the nearest oppositely charged object. This could be a cloud building or ground. A visible discharge is called lightning. Lightning, more prominent from March through November, often occurs during winter months.

Visible lightning starts with an estimated 1 million volt charge. "Bolt" or "arc" discharge current is estimated at 1 million Amps. Often 1 billion horse power is unleashed in a lightning bolt! It's easy to see why lightning doesn't need to strike in the same place! Once will do it.

Humidity and air particle conditions many times limit discharges to lower levels. Often these low level discharges are invisible. These disruptive lower level discharges may accompany snow, wind and sand storms. Both lightning and lesser invisible atmospheric discharges create large magnetic fields, generating high voltage spikes and surges in surrounding metallic objects including power and phone lines, signal cables and dish control lines.

Nearby discharged induce spikes and surges in these lines. Lightning induced spikes/surges can reach several thousand volts amplitude in power and phone lines. Control and signal lines may experience up to 1000V spikes and surges. Invisible atmospheric discharges may generate 1000V on phone or power lines and 500V on signal cables or control lines. Energy in these spikes often reaches several hundred joules. Spikes due to atmospheric discharges are usually between 10msec and 100msec in duration. Often a discharge generated multiple spikes.

Electrical equipment such as furnace motors, refrigerators, vacuum cleaners, air conditioners, welders and other machinery generates spikes up to 1000V directly on the ac power line. Duration of these spikes is generally between 10msec and 1msec. These spikes are carried by building wiring to all connected equipment. Sometimes, spikes can be carried to neighboring houses or farms.

Spikes and surges, whether atmospheric or manmade, are accompanied by large bursts or interference. This interference is also carried over

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the electrical wiring to connected equipment, and will also affect the neighbor's satellite system.

Switchgear and equipment employed in power company generating plants often create significant spiles, surges and interruptions. These damaging spikes and annoying interruptions are carried over the power transmission network to all connected farms, homes and equipment. Power company spikes may reach 1000V amplitudes with durations up to 1msec and are accompanied by massive interference.

Spike and surge control

Short of a direct lightning hit, spikes and surges can be successfully suppressed before entering expensive satellite equipment. Supression techniques employ either metal oxide varistors (MOV's) silicon diode transient suppressors or gas discharge tubes.

Gas discharge tubes are available that pass 5000A (surge) for about 20msec and 1500A (surge) for 1msec. Energy absorption uses about 50 joules. Although handling relatively high current, these devices have several inherent drawbacks. They cannot be paralleled to extend current handling. Response time is very slow, reacting in 0.5 to 1msec. Once ignited, gas tubes remain "on" until tube current drops to a few mA. Although used in some older designs for ac power transient suppression, they're rarely used in modern equipment.

Silicon diode transient suppressors are medium duty, zener-type devices specifically designed for fast reaction time and failry heavy current. While capable of 1psec reaction time, typical diode suppressors can only handle 150A (surge) for 20msec and 35A (surge) for 1msec. Energy absorption is 2 joules. Extremely fast reaction time is major advantage. Suppressor diode surge current limitations are a major disadvantage. Parallel diode operation is possible, but not very effective.

Metal oxide varistors (MOV's) are relatively fast, reacting in about 10msec to 35msec. Individual units will will dissipate up to 6500A (surge) for 20msec and handle 180A (surge) for 1msec. Energy absorption is about 70 joules. Units can be paralleled to obtain greater surge current handling capability. MOV's are the most widely used suppressors in present day spike/surge control equipment.

Hybrid suppressors employing diodes and MOV varistors provide extremely fast diode response, combined with the heavy surge current capability of MOV's. Parallel metal oxide varistors further extends suppressor surge current capability. Good fusing provides "fail open" operation.

Disruptive noise and damaging spikes usually accompany each other. A wise course of action would be to use a high-speed, high-surge current ac power line supressor to prevent equipment damage. Coupled with the heavy duty supressor, a wide band RFI/EMI interference filter should be used to reduce chances of equipment malfunction, memory scrambling, control errors and program interference.

Field studies have shown that every location in the United States receives a spike of 1000V greater every month. To combat these damaging spikes, a heavy duty supressor of at least 30,000A (surge) should be installed on ac power lines. Ideally, high speed supressor diode should be incorporated to control spikes with ultra-fast risetimes. Heavy duty internal fusing should be included to disconnect power mains if an extremely high energy spike is encountered.

High surge current MOV's should be provided for control line protection. Supressor protection for dish signal lines is extremely advisable.

It is the author's experience that properly engineered, high surge current suppressors will provide equipment protection for extended periods. Analysis of supressor diodes and MOV's after 10 years of field service has shown no component performance deterioration.

Conclusion

Spikes, surges and interference often cause satellite system damage, memory scrambling and interruptions. Installation of suitable supressors and filters on the ac power line, control lines and signal cables can reduce risk of costly damage. Annoying interruptions and interference can be reduced or eliminated. Re-programming expense and inconvenience are eliminated. The end result when using a high performance filter and supressor system is improved satellite reception, more customer satisfaction, better performance and longer equipment life. ■

Test your electronics knowledge

By Sam Wilson, CET

1. Which of the following diodes is normally operated with a reverse current?

A. Zener diode
B. Varactor diode
C. (Both choices are correct)
D. (Neither choice is correct)

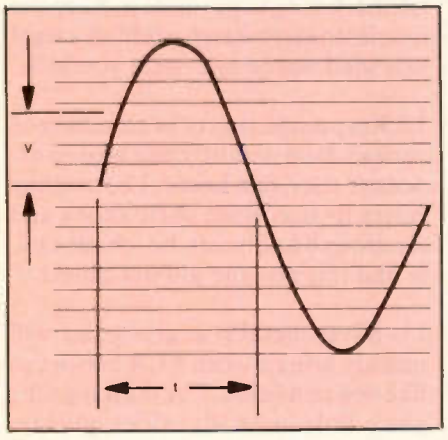

Figure A

2. Refer to the oscilloscope display of a sinewave shown in Figure A. The period of time marked 't' is 0.002 seconds. What is the frequency of the wave?

3. For the sinewave display of Figure A: V = 10V. What is the RMS value of the displayed voltage?

4. If you multiply the RMS voltage (V) by the RMS current (I) in the circuit of Figure B you will get

A. the RMS power dissipated by the resistor
B. the average power dissipated by the resistor.

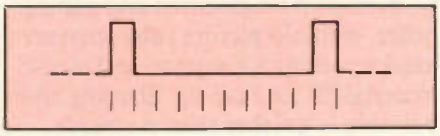

Figure C

5. The duty cycle (also called duty factor) of the waveform in Figure C is?

6. Which of the following is used for measuring radiant energy?

A. Goniometer
B. Bolometer

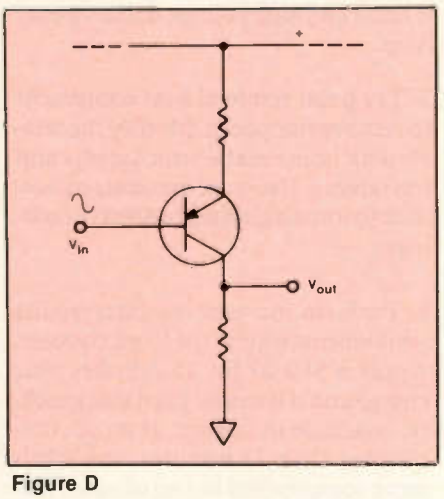

Figure D

7. For the circuit of Figure D the output signal is

A. in phase with the input signal
B. out of phase with the input signal.

8. In the op amp circuit of Figure E the voltage at point X should be

A. +10V
B. −10V
C. $R^1/(R^1 + R^2) \times 20$
D. (None of these choices is correct)

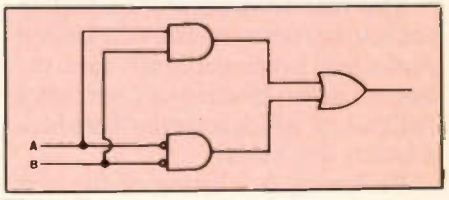

Figure F

9. The circuit in Figure F is

A. an EXCLUSIVE OR
B. an ENABLE
C. a LOGIC COMPARATOR
D. (None of these choices is correct.)

10. For the aural transmitter of television broadcast stations 100% modulation occurs with a frequency swing of

A. ± 25 KHz
B. ± 50 KHz
C. ± 75 KHz
D. ± 100 KHz

(Answers on page 44)

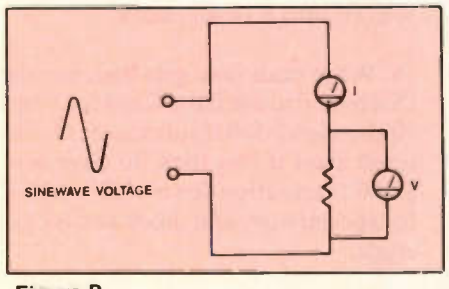

Figure B

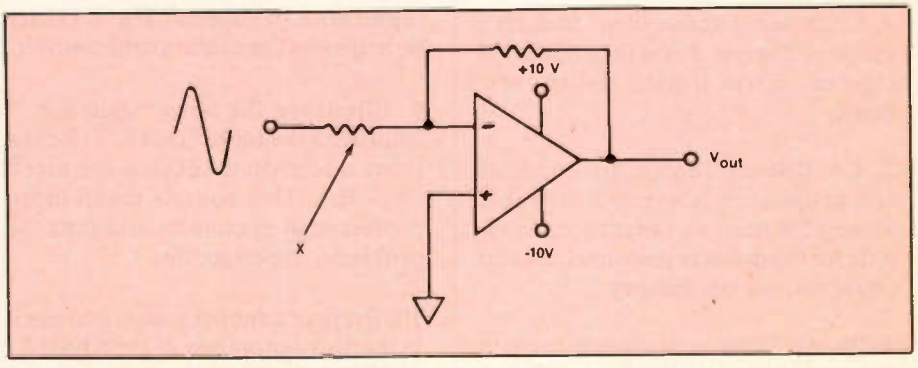

Figure E

Wilson is the electronics theory consultant for ES&T.

A few good ideas for service centers

Every year at the National Professional Electronics Conference (NPEC), an annual convention and show held by the National Electronics Sales and Service Dealers Association (NESDA), attendees have a meeting at which they share ideas with each other for improving the operation of their service centers. It's called the Best Idea Contest. Some of these ideas are actual servicing tips, some suggest ways to improve business operations, some suggest ways to avoid waste or to improve customer relations.

This year, servicing professionals in the southeastern region of the United States held a regional conference, the South Eastern Electronics Conference (SEEC), at which a similar Best Idea Contest was held.

Following is a listing of the best ideas generated at both of these events, generously shared with all **ES&T** readers by the people who generated them.

Contest Ideas

NESDA Convention August 1991

1. To minimize costly destruction of horizontal output transistors, use external mounting fixtures, clip lead attach shielded cable for base and emitter, separate line for collector. Use heavy duty heat sink and test output transistor. Utilize light bulbs where current sensitive. Speeds up testing for defective flybacks.

2. Continuing above idea: heat sink mount a damper diode for additional time in current tracing flyback systems.

3. Use delivery specialist companies for projection television drayage. Have VCR hook up instructions available for the delivery personnel to hand to set owners on delivery.

4. Place a 250W incandescent lamp in the ac input circuit of a television repair station. After becoming familiar with normal actions, watching the filament on turn on will indicate problems and assist in faster repairs.

5. Cracked plastic TV and VCR cabinets can be repaired very professionally, even with fragmented and gaping holes, with old picture tube aperture mask screening for support and plastic material fill for shaping. Shaping and painting is quicker than it sounds.

6. If your bank has the system available, place a terminal on your desk to watch deposits and withdrawals from your company accounts. Some credit cards and special deposits will get lost or delayed if they are not tracked properly. This also allows business owners to more closely monitor financial activities. More needed in retail and high volume dollar operations.

7. Try paint removal heat equipment to remove flat packs. Modify the nozzle with home made attachments and restrainers. Use trace amounts of acetone to loosen glue and adhesive coatings.

8. Perform inexpensive auto repairs while clients wait at the front counter. Apply a $10.00 for 15 minutes time charge and if it can be fixed that quickly, conclude the repair. If more complicated than 15 minutes, the job is more complex and not repairable, limits this battery terminal and readily repairable problems. Have refurbished units for sale at front counter.

9. Eliminate the term "callback." Eliminate the term "recall." Use the term additional service required (A.S.R.). This sounds much more professional at counter and puts the problems in perspective.

10. Prepare a rubber stamp and use it in the distributors box of the NESDA/NARDA form to list the contract number and authorization number of third-party warranty work. This will be an alert box for the technician to watch before going out on and performing third party warranty work without the proper details filled into the repair form.

11. Create your own extended warranty plan. Handle it in house and use telemarketing to promote it. Keep the monies in escrow and establish a legal extended warranty system yourself.

12. Keep a selection of brass tubing of various diameters to repair broken expensive television knobs. Use a tubing cutter to size. Split shaft knobs and semiround knobs can be rebuilt easily and this gets the job out quickly.

13. Silver metallic engine paint will quickly bring a worn VCR cabinet to like new condition. Use masking tape and a little ingenuity. Dries quickly.

14. Old antenna tubing can also be used to repair old TV knobs. Use sealing wire (strong and flexible) wound around the shaft for really odd sizes.

15. When running speaker and antenna wire in a cosmetically sensitive home, use a coat hanger as a long and very tiny pilot hole drill. Makes a very long drill bit and leaves an extremely tiny hole. Using a diaganol cutter, cut the long straight hanger portion from across the bottom. Cut the front on a diagonal as a drill bit, the rear flat. Will fit into a small chuck.

16. When cash flow gets bad, use the Discover Private Issue Card for 5 and 10 thousand dollar advances. No interest paid if less than 30 days out. $2.00 transaction fee is well worth it for special buys and quick needs coverage.

17. Use a rubber stamp with bright ink on the NARDA/NESDA form to remind the on-site service technician

that a manufacturer's sticker is needed from the inside of the service product. This saves going back for the sticker.

18. Establish a pre-employment test for technical applicants. Take the NESDA/NASD sample and modify it for what products apply to your business.

19. Mix customer relations questions into your pre-employment test. Will help you know more about the temperament of the applicant. Talk to them when reviewing the answers to find out reactions.

20. Establish a part number for chemicals and cleaners. Suggest "CL-500" and establish a pattern of products and value for pricing. This would provide its own identity as a parts line item.

21. Charge a service library fee on repair invoices. With many service centers inventorying over a hundred thousand dollars in schematics, this is a reasonable and accountable line item.

22. Find inexpensive surge protectors with insurance coverage and sell tham at front counter and at site.

23. Create a containerized system to store camcorders whie they are waiting for parts. Purchase sturdy cartons with tops and label clearly. Stackable cartons are easier to store.

24. Use plastic egg cartons to store and sort screws in a workbench environment. Have a label system to track various screws and washers and nuts and spacers. Colored dots will help.

25. Use fine gauge steel wool to clean wire leads before soldering.

26. When using a color code for tracking screws, have color coded plastic bags to transfer the screws to while the repair item must stay in "Waiting parts" storage bins.

27. Color code each repair using stationery store dots: red for rush work, blue for normal, yellow for casual, green for rebuild for used sales.

28. Develop an advertising tracking system at the front counter and with incoming phone calls to determine where the client heard about you. This allows you to determine what advertising methods are most effective. Suggestion: Ask what page of the Yellow Page Book is being viewed to better determine more useful YP categories.

SEEC Conference Atlanta - October 1991

1. When you're working on a horizontal transistor and you suspect transformer problems use a Variac and heat shield mounted output transistor and specifically placed indicator lights to diagnose and minimize damaged new components.

2. Investigate some automotive brake chemicals to restore rubber belts and pulleys.

3. Look for small local business newspapers to promote business changes. Often they are looking for information and usually the coverage is at no charge.

4. Create a tag or stamp to apply to site call invoiced and NESDA/NARDA forms to remind all office and technical people to confirm the authorization numbers when doing warranty work. This tickler system will help everyone keep aware of needed authorization numbers and stickers.

5. When faced with an unhappy set owner, have a coupon ready to appease. A suggestion is to enlarge a twenty dollar bill, put the company picture in the middle and declare a one year expiration date - makes good and impressive coupon.

6. Have a parts box at the front counter. Old parts for show and tell. When clients ask about soldering time and repairing printed circuit boards and installing video heads, most people do not realize what's involved. Showing samples of camcorder boards with assemblies and television modules can make the explanation much more credible.

7. Use different color post cards to notify clients of various repair details. Suggestions: Use blue to notify for parts hold. Use yellow for estimates. Use green when set is ready. Often owners will call and say they received a card but forgot what it was about. Call takers can ask them what color card the card was and know what the card was sent for.

8. Have everyone at the front counter ready to at least recognize the entrance of each incoming client. Even if every employee is very busy, at least make eye contact and recognize the presence of each person. This acknowledgment is good manners and good business.

9. When working with subordinates, avoid using the term "employees." Use the person's business title and never talk down. Always try to speak on a business level and not on a belittling level.

10. Create a $10.00 coupon to encourage set owners to bring additional other product in for repair within the next six months after service. Always have an expiration date. Do not tag to the repair, mail out after the repair process.

11. Try using free estimates by letting the owner know that if the repair will cost more than half of the equipment, they will be called.

12. Popular mode television and VCR products can be given an estimate just by the client complaint because of the familiarity of the technician. This would be available only if a working technician was readily available to the front counter.

13. At the front counter, on product pick up, always explain your guarantee and give the set owner your personal business card in case they have a problem. This problem relation will create good will. It does require that front counter people have personalized business cards and use them properly.

14. Begin a quality control system by phoning set owners after the repair. Do random checks if all cannot be called. Ask if they were satisfied with the workmanship and the company attitude.

15. Give free ball park estimates. Charge for detailed estimates, and call it a diagnostic or evaluation fee, not an estimate or deposit fee.

16. Have a front counter script written so each client gets the same information read to them at the incoming counter. Avoids conflicts and incorrect information being told to clients.

17. Post rates at the front counter. Use large signs so that there is no confusion. Point it out to clients and read word for word.

18. Communicate with clients on the repair invoice. Give explanations and details of what repairs were done and what tests were run. Don't just list part numbers. Owners enjoy some technical explanation and not just a simple line of time charges.

19. Have a professionally done endless loop audio tape done for the company phone on hold messages. Explain your location and your company hours. Explain special activities and sales. This sounds professional when done right.

20. When using radio advertisement, have the announcer do the spot live rather than taped. This will get much better coverage and better recognition. Often you receive more that the 60 seconds time exposure because of comments and often casual time allotments.

21. It is not always a great idea to tape the old parts to each repair. A set owner could ask to see where it came out of and waste time challenging the repair.

22. Keep a computer track of past services, with the repair total fields available, by make and model number. If a set owner wants an estimate, pull up the make and model's typical history and explain what the computer shows.

23. Wrap all repaired items in plastic bags to present a professional look to the owner on set repair pick up. Purchase bags in three sizes to accommodate most items under 19 inch televisions. Be certain the bags are marked with the proper warning for children.

24. Use heavy reusable plastic bags and cartons to hold repaired units in. These can be re-used and are less damaging to the environment. Avoids more plastic waste.

25. Be very certain to clean up each repaired unit. Dusting and wiping takes little time, but no matter how much time is spent inside, the perception of a good job is still what can be seen by the owner.

26. Program your computer system so that it will not allow a unit that does not have a serial number to be received with no serial number. Avoids service center responsibility for having less than legal property in custody.

27. Try putting your picture in your yellow pages advertisement. Gives a personal attitude and approach for someone to feel more comfortable when calling for service.

28. When returning rejected claims, have ready a selection of specially colored envelopes when submitting. Have prepared with notice on front stating "special billing - process immediately." This adds some concept of expediency to the envelope's contents. And warranty claims processors can use some sense of our urgency. ■

SAVE TIME

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Test your electronics knowledge

Answers to the quiz *(from page 41)*

1. A - Both are operated with reverse voltage.

2. A complete cycle takes 0.004 seconds (T = 0.004 sec)
f = 1/T = 1/0.004 = 250 Hertz.

3. The peak voltage is 20V. Therefore V (RMS) = 0.707 × 20 = 14.4V.

4. B - Only in audio systems do you get the term "RMS Power". It is a term that is not related to the real world.

5. 0.111. Duty cycle = on time/time for 1 cycle = 1/9 = 0.111. Duty cycle is sometimes expressed as a percent value.

6. B - A goniometer is used with a combination of antennas. It permits the directional response to be altered without moving the antennas. A bolometer is an example of a component that can be mounted in a waveguide and used for an indirect measurement of power.

7. B - The amplifier is in a common-emitter configuration. Therefore, the input and output signals are 180° out of phase.

8. D - The point marked 'x' is called the virtual ground. The voltage at that point should be about zero volts.

9. C - There is an output only when A = B.

10. A - this is part of the overall NTSC standard for TV broadcasting. ■

AMAX means enhanced AM radio

By John Shepler

Two dominant industry groups, The National Association of Broadcasters (NAB) and The Electronics Industries Association (EIA) have teamed up to launch a multi-million dollar campaign to develop and promote high fidelity AM reception.

The AM band was the most popular source of radio entertainment until about 10 years ago. It has since shriveled to second-tier status, now largely carrying news, talk, and sports shows. The FM band is where most listeners tune for high quality music programming.

Can AM stage a comeback? It's certainly an uphill battle. AM receivers have little cost advantage anymore. Nearly all radios that pick up AM also tune FM. AM has been limited by increasing noise and static, skywave interference at night, lack of a stereo standard, and poor audio fidelity.

AM radio does have some advantages, though. The FM band is nearly full in many locations. This means few or no new stations.

AM reception is also superior in many cases. Over long distances, the ground waves of high power stations follow the curve of the earth, making reception possible for hundreds of miles. In densely packed cities the AM signal suffers fewer dropouts due to its longer wavelength and ability to wind around obstacles.

The joint NAB/EIA effort is called AMAX. Receivers that meet the AMAX standard will have a certification mark or sticker. You should start seeing these any time now.

What improvements does AMAX make? Audio bandwidth is expanded to a minimum of 7.5kHz on home sets and 6.4kHz on mobile radios. Some new designs will be flat from 50Hz to nearly 10kHz with a notch filter to remove the high pitched sqeal that otherwise occurs when adjacent channel carriers mix in the receiver.

A 10kHz response certainly falls short of the 15kHz standard for FM broadcast, but for car radios and smaller home systems the difference is hard to notice.

In addition to expanding frequency response, transmitter and receiver manufacturers are also working to reduce distortion to FM standards.

Another big improvement is the addition of noise blanking circuitry. Noise blankers mute the receiver for the few milliseconds that a static burst occurs. This is too fast for a listener to notice. It effectively removes much of the cracking and popping noise characteristic of the low frequency AM band.

Along with noise blanking, AMAX receivers will have manual or automatic bandwidth control. This will reduce high frequency hiss under noisy conditions. It works something like turning down the treble to make weak stations listenable.

AMAX receivers will have provisions for an external antenna. Many AM radios now use only an internal loopstick with no outside connecting terminals. This will help long distance reception.

A major change to the AM band is the near doubling of the band size by adding a new segment from 1605kHz to 1705kHz. Some AM/FM receivers already have the ability to tune this new band. Within the next few years, many stations will relocate from the lower to the upper segment, greatly reducing the interference on the present AM band. AM can then return to its roots as a long distance broadcasting service.

Interestingly, AM stereo capability is not being mandated. The United States made an unprecedented decision some years ago in allowing incompatible, competing AM stereo systems. There are only two such systems remaining, the Motorola CQUAM and Kahn ISB schemes. Of these, Motorola has the lead worldwide. AMAX receivers that have stereo capability will carry a special AMAX-Stereo emblem.

Receiver manufacturers that are introducing AMAX receivers include Delco for GM cars, Denon, GE, Carver and perhaps Sony and Sanyo at a later date.

Promotions for the AMAX improvements will swing into high gear this spring. You'll hear announcements on AM stations and see the receivers start to appear on dealer shelves. Will this be enough to resuscitate the ailing AM band? We should know the answer by 1993. ■

Shepler is an electronics engineering manager and broadcast consultant. He has more than 20 years experience in all phases of electronics.

What do you know about electronics?

It moves!

By Sam Wilson, CET

I know there are engineers and technicians who cannot stand the thought of anything moving in an electronic circuit. If you have been watching this aspect of circuits you know that any component that has a moving part is tabu—even if that component is the best one for the job. A good example: the relay.

I am aware of that, but, I now give you a circuit that has moving parts. See Figure 1. It is a multivibrator made with relays. If you decide to build it you should know that it is a little bit touchy, but once you get it to work it is very reliable.

O.K. - I have done my part in eliminating the fear of components with moving parts. Now I have one question. What can you do with it? I am looking forward to hearing from you.

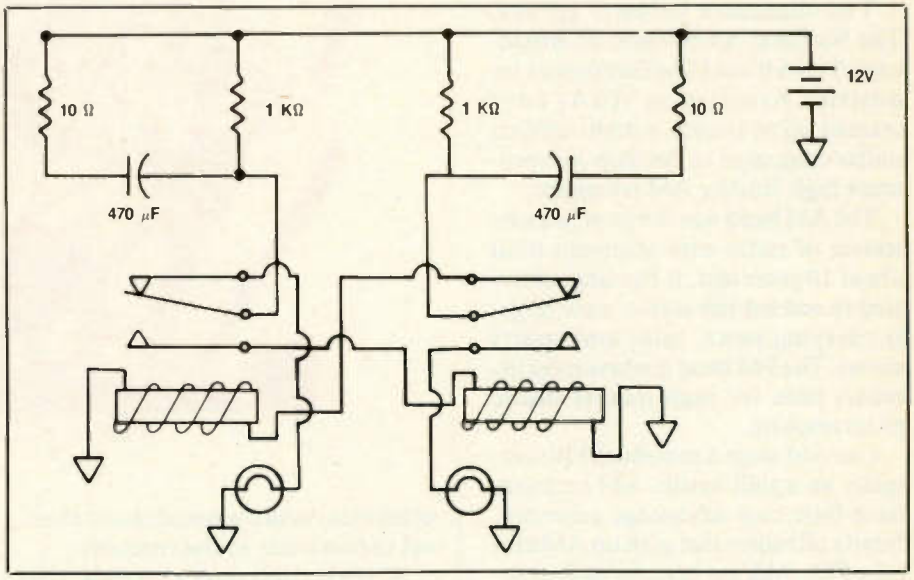


Figure 1

Letters I cannot handle

I need to tell you this again. Please do not send letters to me asking about the CET testing program, or the CET test, or about ISCET. Send those letters direct to the testing agency!

Here are some new ways of looking at ideas that have been discussed before.

The 1,000,000 farad capacitor

The capacity of a capacitor is given by the equation:

$$C = K A/d$$

where: C is the capacity in Farads K is the dielectric constant A is the area of the plates facing each other and is the distance between the plates.

If you cut a piece of solid cooper wire so that the faces of the two halves are parallel, as shown in Figure 2, you have a very small capacitor. The ends of the wire serves as the capacitor plates. As indicated by the equation, the closer the "plates" the higher the value of capacity.

Wilson is the electronics theory consultant for ES&T.

Once you have cut the wire and polished the ends so they are perfectly flat, the next step is to spray the ends with a light coating of insulation. That gives the capacitor a higher breakdown voltage. Then, place the ends so close together that the capacity is 1,000,000 farads.

Package the capacitor by dipping it in a plastic coating. Use your capacitor as a filter in a 1.5V power supply. Let me know how it works.

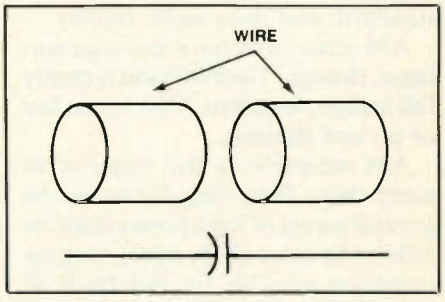


Figure 2

Proof that 2 = 1

I don't think this one will ever die. One reason is that it teaches a very important basic rule of arithmetic. Start with the assumption that A = B. Then:

$A = B$
$A^2 = B^2$
$A^2 - B^2 = AB - B^2$ (Because $A^2 = AB$)

Factor (A − B) on both sides of the equation.
$(A - B)(A + B) = B(A - B)$

Cancel (A − B) from both sides.
$A + B = B$

Since A = B, substitute A for B.
$A + A = A$

Add A + A to get 2A
$2A = A$

Cancel A from both sides.
$2 = 1$

Knowing this makes it much easier to balance your checkbook. (Discussion at the end of this article.)

How to refuse

Suppose someone jumps out a fast taxi and asks if you have a 60A fuse. All you have to do is reach into your pocket and pull out the few inches of

-4 wire you keep handy. Cut off a fuse-length of the wire and tell him to use it as temporary a fuse.

Don't give him your name! There are a lot of people just looking for someone to sue. (Don't give him my name either.)

Is there anything left to work on?

I wonder if some of the great experimentors of the past would be able to make a mark in the world today. It is very difficult for home experimenters to complete with large industries. This is especially true if the home experimenter is trying to get something on the market that will make money.

If money isn't your main goal, there are some subjects you can attack without a big investment.

The world of science is still working on theories of light. Some think it is a wave and others claim it is made of particles. There have been some attempts to combine those theories but someone is going to have to come up with something better than we have now.

Here is a need that may surprise you. We still do not know what electricity is. We know how to use it. We can feel it. But, the fact remains that we don't know exactly what it is. Have a go at that.

If you lean toward making gadgets, try working on this one. Design a navigation system that permits you to leave a 2-ft square area in Canada and go to a 2-ft square area in Florida. Then, return to the 2-ft square area in Canada months later. You are to package this navigation system into a cabinet no larger than a bird's head.

While you are waiting for your money to arrive for that one, try this one. You are to design a sonar system that can sense the presence of an aluminum pipe that is 2 inches in diameter. Your system must know of the presence and direction of the pipe. Also, it must fit into a package the size of a dolphin.

We know that the last two ideas are possible. Brilliant electronics technicians and engineers have tried for years to mimic some of the capabilities of animals. This field of science is called bionics.

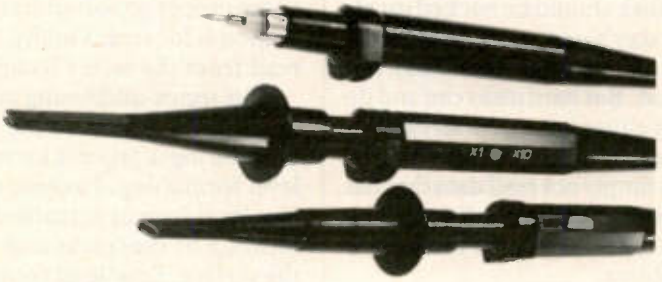
Writers like to compare the computer with the human brain. Technical people strive to get brain-like computers. However, they can't succeed for a simple reason. They are trying to accomplish their goals by building hardware and software. If you look at the organisms they are trying to copy you will see that the thing they always leave out are chemicals. You cannot simulate systems that operate with hardware and chemicals by using only hardware and software. Your imitation must also use chemicals.

The breakthrough in bionics will come when some smart person (you?) makes a system that combines hardware, software and chemicals. Think about it.

Answer to 2 = 1

If A = B, then (A − B) = 0. When (A − B) is "canceled", both sides of the equation are being divided by zero and that is against a very basic rule of arithmetic. ■

STACK PROBES
the difference is IT'S BETTER

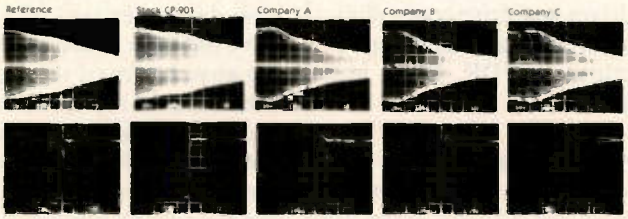


The difference is it's better. And being better gets you to the right answers. The right answers save you time, energy and money.

The difference is Stack is a leader in research and development of probe construction. Stack's expertise in this area has introduced advance construction procedures which decreases noise, vibrations and shock, and increases a very high linearity of frequency response throughout the bandwidth.

More makers of signal analyzing equipment use STACK PROBES than any other brand, because it is better. It is the 'better' that is built into every Stack probe, that gets you to the right answers – that makes a big difference.

STACK PROBES — Test Results show just how much better we really are.



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Circle (74) on Reply Card

Keeping PC hard disk drives up and running

By Steve Gibson

Today, most personal computers contain hard disks that often end up being a source of frustration both for the users and for those who support and service the PCs. Users expect that the data stored on the disk will always be available for use. Even though they are warned over and over again that the hard disk should be backed up after every day's use, most users don't really think that their hard disks will ever go bad. But hard disks can and do fail. They either fail due to an electromechanical problem, or because the drive will simply not read data that has earlier been written to the disk. The inability to read data is a far more common problem.

Products exist on the market that can prevent "inability to read data" problems from ever occurring. These products perform functions such as testing the disk's surface looking for defects in order to mark the bad sectors as off-limits for new data; rewriting the low-level format so as to realign the heads and the tracks on the disk; and tuning up the disk drive in a variety of other ways. Some of these products can even recover data after it is seemingly lost. Although some of these products only work with basic classes of drives and drive controllers, others can perform at least some of their functions on IDE, ESDI and even SCSI drives.

Hard drive construction

All hard disk drives have one or more surfaces coated with magnetic material. Each surface is subdivided into a number of tracks, and each track is divided into smaller pieces called sectors. Sectors begin with special sector-addressing information, followed by 4096 data bits organized into 512 bytes. Drives that use MFM encoding store 17 such sectors per track, while drives that use RLL encoding squeeze 26 sectors into the same space. When a drive is looking for a sector, the heads are first positioned over the appropriate track and then the track is continuously read until the proper sector-addressing information is located. Finally, the data is read from the sector location.

This sector-addressing information is originally written to the disk's surface during a process known as low-level formatting. In other words, the low-level format actually defines the location of the tracks and sectors on the surface. Low-level formatting differs from the normal format command that exists in DOS.

The DOS format command

The DOS format command when used on a hard disk does several things, the most important of which is to erase the File Allocation Table (FAT), which records where each file is located on the disk. Without data in the FAT, the computer cannot locate any files on the disk drive.

Once the FAT is erased and reinitialized, the computer is free to rewrite new data over sectors that already have old data in them, thus eliminating any chance of recovering the old data from the drive. If a drive has been formatted in error, but new data has not been rewritten into the old sectors, there are utilities on the market that can rewrite the original FAT, thereby recovering the lost files.

Problems with the low-level format

One of the major problems that lead to hard disk failures is the aging of the low-level format. If the sector location information cannot be accurately read by the drive's head, data cannot be located on the drive. Every time a sector's data is changed, the entire sector is rewritten, thus strengthening the magnetic image of the data in that sector.

The sector-addressing information put down during the low-level formatting is never rewritten. It sits there, slowly fading away, until the disk controller is finally unable to locate the sector at all. That's when DOS sends those undesirable SECTOR NOT FOUND messages. It is clearly much more desirable to occasionally renew the magnetic strength of the sector-addressing information.

Another leading contributor to the SECTOR NOT FOUND problem is alignment drift due to long-term change in the relative position of the head and the track. If the track is not where the head positioner thinks it should be, it can't be read. Because the head positioner is a mechanical device, any wear in the mechanics of the head positioner results in misalignment of the head and the track.

The gradual drifting of the head's position relative to the track doesn't hurt the readability of the sector's data, because newly written data is positioned exactly underneath the current location of the read/write head. However, the gradual drifting of the drive's alignment drastically affects the drive's ability to find the sector in question, because the low-level format, which is always required to identify the sector, is never rewritten, and thus gradually becomes misaligned.

With time, the drive's heads can drift far enough from their original alignment that even newly written data cannot be found, because the sector cannot be found. If the low-level format of the drive is periodically rewritten, this problem will never arise.

Voice Coil Head Positioners

The type of alignment drift just discussed applies primarily to drives that use stepper-motor head positioners. An alternative high-performance head positioning technology, known as

Steve Gibson is president of Gibson Research Corp., and also a regular columnist in InfoWorld. Gibson Research Corp. is the developer and marketer of SpinRite II, the hard disk utility program.

voice coil positioning, uses an active feedback approach to improve upon the stepping motor's dead reckoning positioning.

In active feedback positioning, either one of the drive's heads is dedicated to the task of following tracks on a special servo surface of the drive. Servo information is embedded between the sectors on the disk's surface and the same heads that read and write data, seek the proper sector by reading the embedded servo information on the data surface.

By actively following the tracks on the servo surface, or by reading the embedded servo information, some aspects of drive wear and tear can cancel out. However, even these systems continue to be plagued by a phenomenon known as tower alignment drift, which affects the placement of each head relative to the others. Even though the servo head is accurately following the servo track, the data heads can still become misaligned with use.

The only ultimate solution to a drive's long term alignment problems seems to be to acknowledge the problem, and then perform an occasional completely new low level reformat on the drive. Only a low level format completely realigns all of the tracks and their individual sector headers underneath the current positions of all the heads.

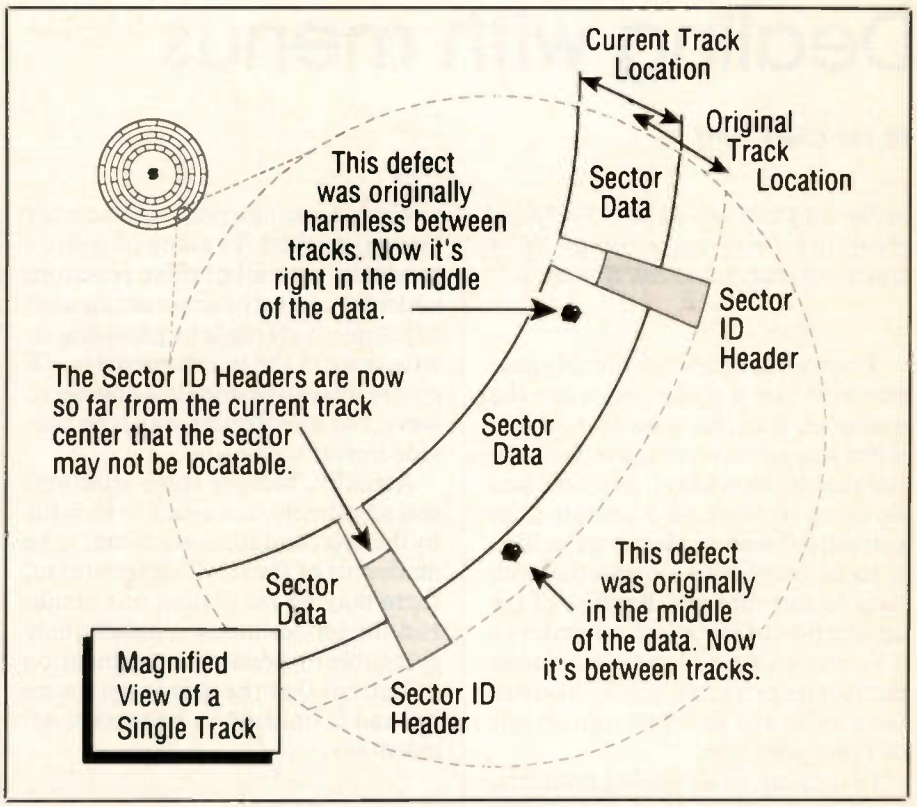

Figure 1. This modified view of a single track on your hard-disk drive illustrates the floating defect problem that can result from head-track misalignment.

The floating defect problem

When a drive is first manufactured, the disk surfaces are scanned and defective areas are noted. When the drive receives its initial low-level format, these defects are normally entered into the formatter, so that the sectors containing the defective spots can be flagged as bad and be completely skipped over by the DOS filing system.

If the head/track alignment drifts, defects that were once located in the middle of tracks, may now "float" harmlessly between the new track locations, which frees once bad sectors for fresh data storage, and new defects that were previously unseen between tracks now migrate directly into the new track locations causing sectors that were good to become unreliable. Thus, even if the tracks are rewritten to align them with where the head positioner is, it is also necessary to rigorously test the track locations for defects and update the DOS filing system with this information.

In addition to the above problems, hard disk drives can also experience a variety of other problems, some of which result in catastrophic format damage. It is clear from this discussion that the best form of preventive maintenance for hard disk drives is the occasional rewriting of the low-level formatting of the drive.

Rewrite the low-level format non-destructively

Two approaches exist for rewriting the low-level format of the drive: destructive rewrite and non-destructive rewrite. Most available low-level formatting software instructs the user to completely back-up the information on the drive. This is necessary since the process of low-level formatting with these products erases all data on the existing tracks. The data must be restored after the low-level format is rewritten.

Products do exist, however, that can non-destructively rewrite the low-level format of most disk drives. That is, they take the data off a track and temporarily hold it in the computer's memory. Then the sector-addressing information is rewritten to eliminate the head/track misalignment, and the data is written back onto the newly located track. All of this is done without destroying any existing data or requiring its backup or restoration.

Such products not only do a non-destructive low-level format, but also check the new tracks for defects to eliminate the floating defect problem. Some low-level format software also tunes up the drive by allowing the user to adjust the sector interleave factor for maximum drive throughput. Improvements in some of these products allow the program to work with more and more different types of controllers and disk drives.

Some low-level format programs can now do thorough surface testing on virtually every disk drive. This wasn't previously possible with most IDE, ESDI or SCSI drive systems. In addition to the test capability, data in bad or deteriorating sectors can be moved to safe sectors, with the bad sectors being marked as off-limits so that no new data will be written to those sectors. ■

Dealing with menus

By the ES&T Staff

Adapted from the Zenith Technical Training Program manual "C-3 System 3 and Advanced System 3."

There was a time when the only time you ever saw a menu was when the waiter or waitress handed you one when you sat down at the table in the restaurant. Nowadays, any time you sit down to work on a computer or computer-based product, you're likely to be faced with a menu that you have to sort through. Because of the application of the microcomputer to TVs and VCRs and other consumer electronics products, you're likely to see a menu any time you turn on one of these products.

In the past, in all-analog products, such parameters as signal source (antenna, cable, VCR, etc.), picture qualities (brightness, tint, color, etc.) and others, were adjusted by switching a switch, twisting a pot, or some other manual method. In many of today's products, with all of these functions under the control of a microcomputer, adjustments are made by providing instructions to the microcomputer. Of course this can be done in a number of ways, but an effective way is to provide menus to the user.

Actually, because some selections and adjustments are meant to be made by the user, and some are meant to be made only by the servicing technician, there may be more than one menu; and the service menu is usually only accessible by pressing a combination of buttons that the user is not aware of, and is unlikely to be pressed accidentally.

The user menu

Figure 1 shows how the user menu on the Zenith System 3 looks. The on-screen menu of all the customer controls is arranged into five main pages or cards: source, video, audio, features and setup. Main pages are set up like file cards. When you select one of the cards, you gain access to the controls in that group. The functions on each of the menu pages are grouped logically so that the menu is easy to use.

The functions are pretty much self explanatory. When the user selects menu from the "Menu" key on the front of the set or the remote control, the TV screen shows the choices available: Source Menu, Stereo Source Menu, Video Menu, Audio Menu, Setup Menu, Features Menu. When the user chooses one of these menus, he can then select any of the controls in that menu.

The service menu

Figure 2 shows the service menu on the Zenith System 3. To access this

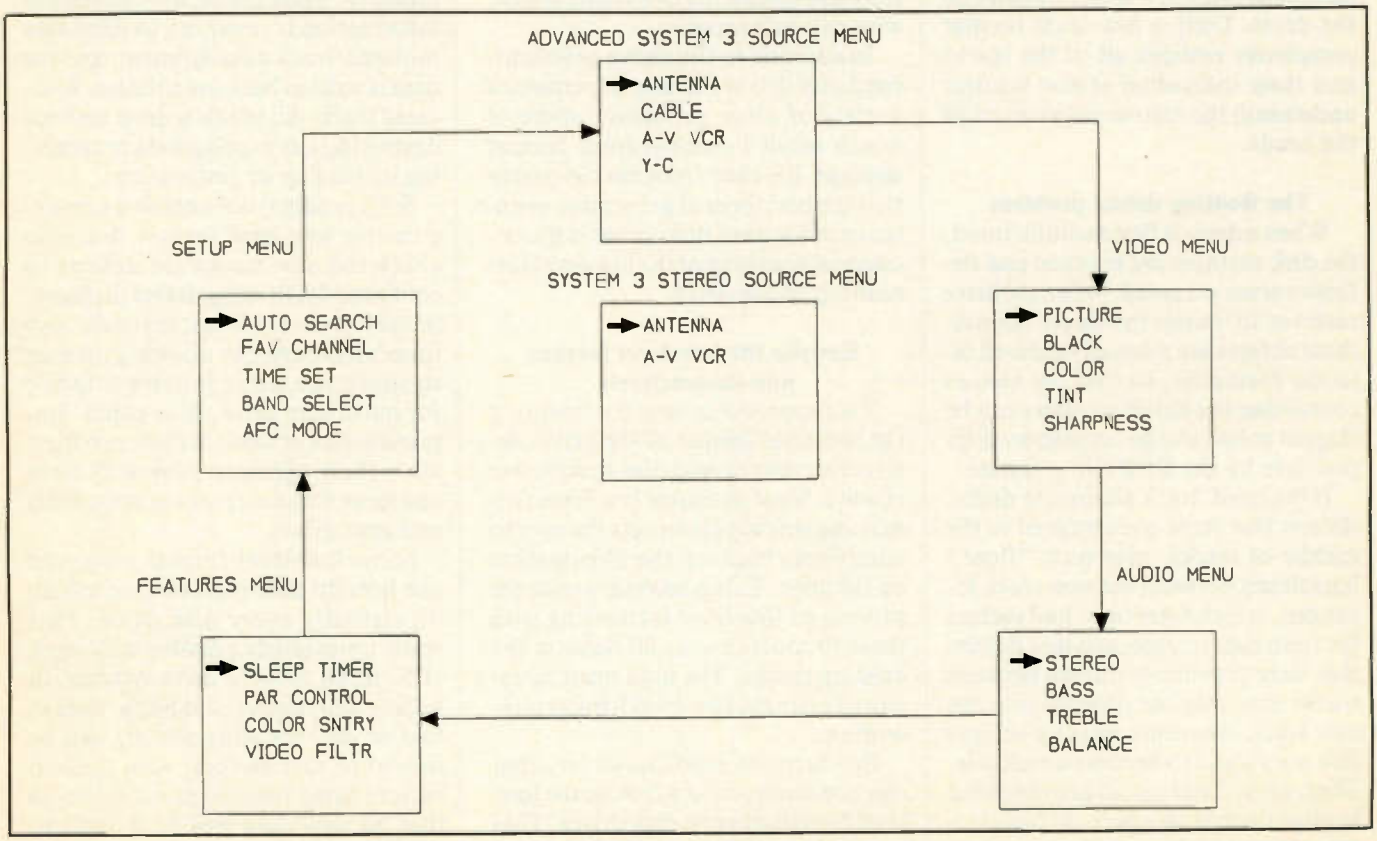

Figure 1

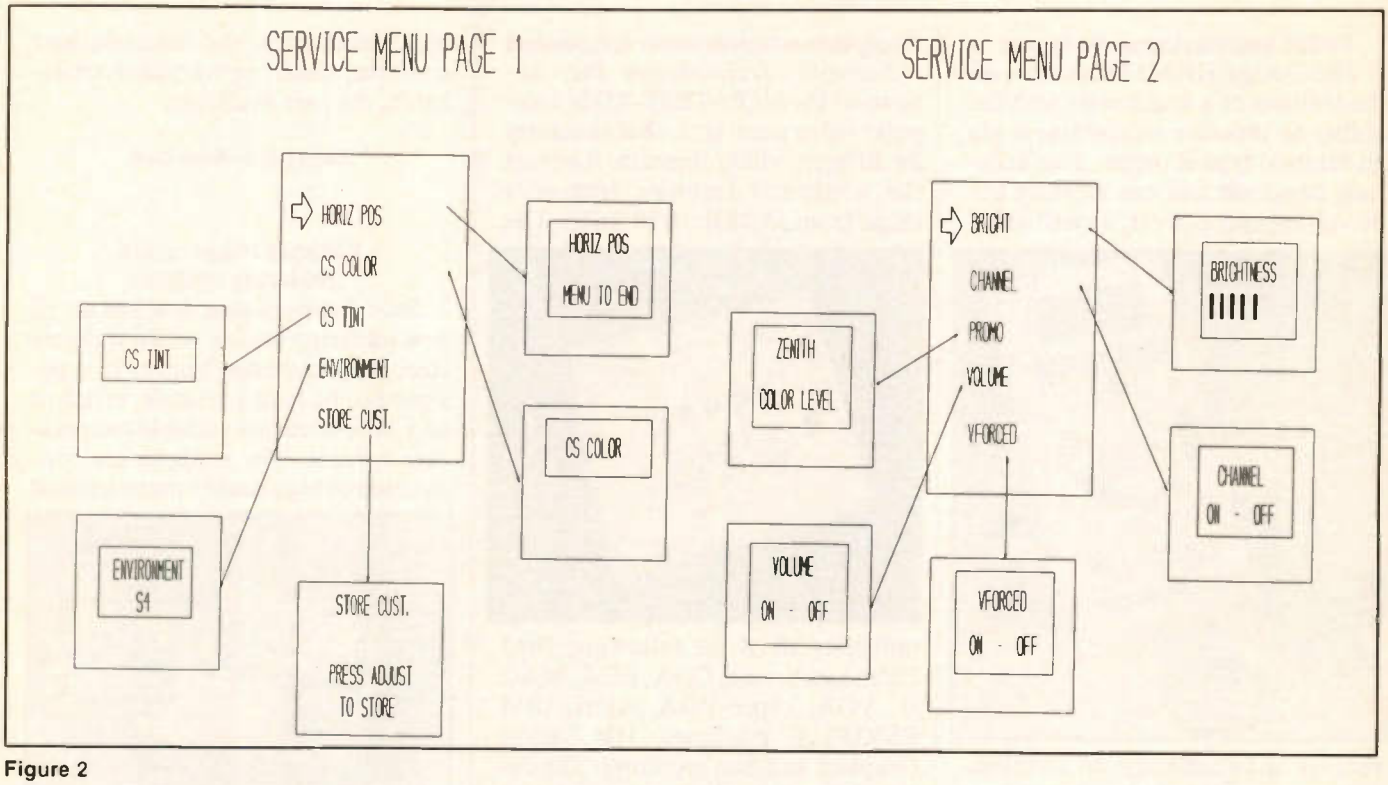

Figure 2

menu it is necessary to press the Menu, Volume Down and Channel Down keys at the same time. This menu is not intended to be used by the customer. This menu can be used by the service technician to adjust such things as the positioning of the customer menu on the screen, setting the color level and tint that will exist when the automatic color and tint are selected by the customer, the brightness limits for the customer menu Picture and Black Level controls, and the upper volume limit.

The need for specific service information

As consumer electronics products become increasingly computerized their controls become decreasingly intuitive. With an analog set, when you encountered a control marked "Brightness," it seemed pretty obvious that if turned it clockwise, the picture would become brighter and if you turned it counterclockwise, the picture would become darker. The same was pretty much true of color and tint, and so on.

Now, with everything under the control of a microcomputer, the controls, and especially those intended for the service technician may be less intuitive. The only way to be sure that you know what you're doing is to have available the manufacturer's service literature. ■

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Circle (95) on Reply Card

DMM and thermometer in one

The Omega HHM57 combines all the features of a multimeter with the ability to measure temperatures via an external type K probe. This accurate, handheld unit can measure ac/dc voltage and current, as well as resistance and continuity. In addition, the user can test diodes, transistors and capacitors. Each comes with test lead set, a type-K beaded wire probe, 9V long-life lithium battery, carrying case and instruction manual.

Circle (6) on Reply Card

Tapes for high temperature applications

3M has introduced lower cost electrical insulating tapes for high temperature applications. These thin, high-temperature-resistant tapes combine new tough propietary film with high temperature adhesives. The tapes can be used wherever high temperature electrical insulating tape is required. Typical applications include motors, coils, transformers, TV yoke/deflection magnets, wrap and fill capacitors, and similar products.

Circle (9) on Reply Card

Computer monitor tester introduced

Network Technologies Inc. announces the MON-TEST-AD24 computer video generator, that simulates 24 different video formats. It covers the horizontal scanning frequency range from 15.7Khz to 89.3Khz. The unit tests all of the following: IBM PC monochrome, CGA, EGA, MAC II, VGA, super VGA, Atari, IBM RS6000, E machines, HP Silicon Graphics and Sun monitors. The device is used to align, converge and color balance the entire range of PC and workstation monitors.

Circle (7) on Reply Card

Multi-format video/all channel generator

Leader Instruments now has a new gen lockable NTSC video test signal generator known as the model 408. The unit provides over 80 test patterns in composite, S-VHS, RGB and Y, R-Y, B-Y output formats with RF channel coverage of all broadcast and cable channels. Up to 100 sets of video level specifications and channel frequencies can be stored in memory for instant recall. The frequencies and video signal-level specifications are set up using a menu driven, multi-purpose data control panel with liquid crystal readout. Over 80 test patterns including multibursts, video sweep, SMPTE color bars, modulated and unmodulated staircase, raster, convergence, crosshatch, ets., are available.

Circle (10) on Reply Card

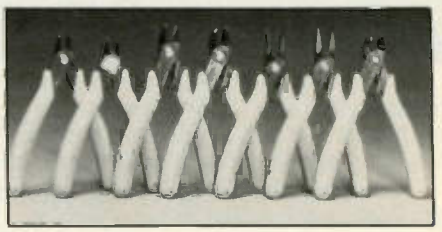
Variable temperature soldering station

Start International now has an all new soldering station with a stainless steel 60W cartridge heater. It is designed to be highly reliable, efficient and offer accurate variable temperature control. The stations are constructed of high quality materials and exceed all military specifications for hand soldering equipment. The unit features an optional 30W soldering pencil, direct readout, extremely large tip mass which offers maximum heat transfer a ±6°F at idling temperature and variable temperature 212F to 878F.

Circle (4) on Reply Card

Cutting tools

Ungar has a complete line of flush-cutting tools and pliers that ensure safety for components and comfort for operators. The shearcutters require less force than most wire and lead cutting tools according to the manufacturer and virtually transmit no shock to components, to minimize the chance of damage. They comply with MIL-STD-2000, DOD-STD-2000 and WS-6536E standards for wire cutting and lead trimming tools.



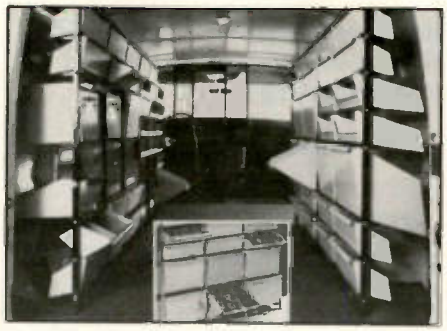
Circle (5) on Reply Card

PC board analyzer

A new automated test system for tracing circuit problems to the component level has been introduced by Maxtec International as part of its new PRO-LINE by *B&K*. When interfaced to a PC compatible computer the model PL5030 digitizes and stored in-

formation in memory about a known-good board or component. That information is later used to compare against a suspect board or component using preset conditions and user-defined deviation limits. Test results are a clear go/no-go indication.

Circle (98) on Reply Card



Van storage system

Compact Van Storage is a system that offers more storage capacity than conventional shelf-type van storage. It features a tilt-bin in side-by-side modules that deliver visual and physical access to all stored parts. It features high density, fast installation, ergonomic design, and versatility, cost effectiveness. The storage system offers three types of tilt bin designs: high capacity; deep bin capacity; and quick view. Accessories include one, two, and three bay cable reel racks; bracket; a two-bay-wide lockable clip-on tool box; and van shelving.

Circle (99) on Reply Card

Handheld digitizing scope

Tektronix introduces a 60MHz handheld digitizing oscilloscope. The 224 extends the capabilities of the popular 222 Family of ultra-portable digitizing scopes into high speed electronics testing applications. Now, electronic service technicians can realize

the benefits of handheld portability and battery powered operation when troubleshooting high speed TTL circuits. Avionics technicians can get the power of a digitizing scope right in the cockpit. Military maintenance personnel can perform accurate equipment servicing in the most remote land operations, or miles beneath the sea.

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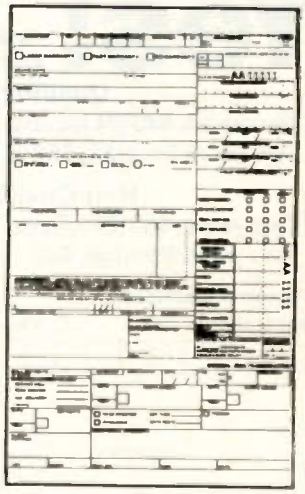

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The NESDA Form

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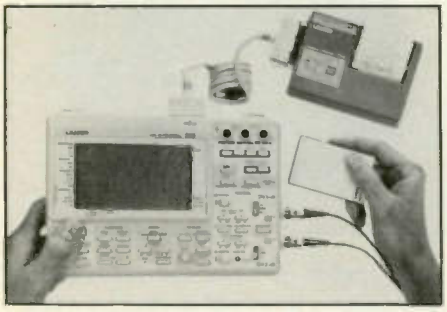
Phone: (817) 921-9061

Data logger, 8 bit logic analyzer

Leader Instruments has announced a new battery powered 30MS/s combination digital storage oscilloscope/digital multimeter. With a sampling rate of 30MS/s, the Model 300 features dual, add, substract and X-Y modes, peak to peak voltage of channels 1 and 2 and frequency readout, plus full auto set-up and autoranging



for both time base and volts per division for each channel. Memory length is 1.8k words per channel and storage of 20 waveforms as standard and up to 80 waveforms with an optional IC card. The IC card makes it possible to save waveform information in the field to be forwarded to the lab for further observation and analysis of troubleshooting data.

Circle (13) on Reply Card

Non-contact volt tracer

Universal Enterprises now offers the new Volt Tracer, VT1K. With Hi (1,5000-122,000 Vac) and Low (25-1,000Vac) voltage detection capability, the VT1K will detect voltage as

far as six inches from the source. When a live source is detected, the VT1K gives instant audible and visual confirmation. Alligator test leads are included with the VT1K and allow easy continuity testing of capacitors, transistors, transformers and wiring.

Circle (14) on Reply Card

Intelligent DMM

Global Specialties announces the PCI-DMM, intelligent digital multimeter on a card for the PC. The PCI-DMM is a virtual instrument using a plug-in card and software package that can be operated like any benchtop DMM. The card provides all the usual functions of the instrument, the software creates an easy to use front panel emulation and the PC gives you intelligence, data storage and graphics facilities.

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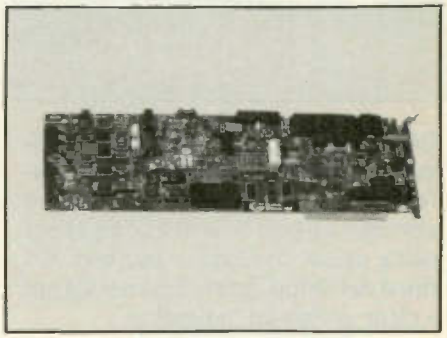

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37 ☐ Electronics Equipment or Components Manufacturer
38 ☐ Goverment and Military; Federal, State, Municipal
09 ☐ Education: (a) ☐ College, Library, School, Including Instructors (b) ☐ Student
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GG ☐ Engineering/Technical & other Personnel Such as Engineer, Technician, Field Service Engineer, Specialist, Engineering Associate and other Engineering and Technical Support Personnel
KK ☐ Other _____ (please specify)

4 Check the statement that best describes your role in the purchase of major electronics servicing equipment and servicing components, accessories and services.
1 ☐ Make final decision to buy a specific make or model.
2 ☐ Recommend make or model to be purchased.
3 ☐ Have no part in specifying or buying.

5 Check the number of Service Technicians employed at your facility.
A ☐ 1-5
B ☐ 6-10
C ☐ 11-25
D ☐ 26-50
E ☐ Over 50
F ☐ Not applicable

Make the most of your yellow pages ad

By William J. Lynott

If you're like most electronics service dealers, you work on a tight advertising budget. Chances are most or all of your ad dollars are invested in the Yellow Pages. Unfortunately, if you're like the typical dealer, a lot of those dollars are being wasted.

A poorly conceived Yellow Page ad is an especially costly mistake, since it requires your commitment for an entire year. Still, I can pick up the YP directory in any city I visit and see page after page of poorly designed ads — ads that are wasting dollars instead of generating profits.

Limited space here prevents an in-depth discussion of effective print ad design, but I can point out for you the most common errors I see in my travels - and suggest that you review your own ads to make sure that your precious ad dollars aren't among those disappearing into a black hole.

One of the most common mistakes made by small service dealers is allowing the YP sales to make important ad decisions. Not that these people aren't qualified to make those decisions; most Yellow Page reps are well trained. But your YP rep is first a salesman. He gets paid on the basis of the revenue he generates . . . period. It doesn't take much imagination to recognize that it is in his best interest to get you to place the largest ad you're willing to buy.

That would be OK if larger were always better, but several independent studies have now shown that that isn't necessarily the case. Quarter-page or even eighth-page ads can be as effective as full-page ads when they are designed skillfully.

So how do you get the most from your YP advertising dollars? Here are a few tips from the pros: First, be sure to monitor the results of your ads. There is no other way to be certain of just how well an ad is producing for you. Asking every caller where he saw your ad takes only a few seconds, and most customers will be impressed by the fact that you asked.

The results of keeping track of the source of each new service call (YP ads, newspaper, referral by a manufacturer, referral by a friend or neighbor, "saw your truck," etc) will probably surprise you.

Most service dealers I know who have done a thorough study of that type over a sufficient period of time discover that Yellow Pages produce a much smaller percentage of their total business than they thought. For those who have been in business for a good while, most new customers come from - you guessed it - referrals of one type or another.

That's a point you should remember. Every dollar you spend keeping your customers happy is an investment in the world's most powerful advertising medium - word of mouth. In the actual design of your ad, avoid these common mistakes:

Don't make your company's name the dominant feature of your ad. Don't set it in the largest type. What you DO, not who you are, is the first point you must convey. You have perhaps a second to grab your prospect's attention. Your company name isn't going to do it.

If you service all brands, if you specialize in one or two brands, if you offer service today, tell that to your prospect in the one or two seconds allotted to you. Otherwise, your prospect's eye will move on to the next ad before you can blink yours.

Don't try to cram too many words into the available space. Advertising pros know that plenty of "white space" around ad copy can be an attention getter. An ad that is too busy will discourage many potential prospects.

Don't try to be cute. Tell your prospect why he or she should call for your service instead of your competitor. Feature your company's strong points. Always try to see your ad through the eyes of a prospect who needs service.

Ask yourself why a prospect should pick out your ad instead of one of the others on the page. If you can't answer that question, you need to take a hard look at the ad's design. If you can't even think of a good reason why a prospect should pick your company, you are quite likely in the wrong business.

I hope that your best reason is not low price. Not that a bargain isn't a good advertising tool. It is. People love a bargain. The trouble is that most people have either had experience with a "bargain" service company or know someone who has.

Service companies built around "the lowest price in town" seldom last over the long haul. Too many shady operators have used this sort of gimmick to lure customers who soon learn the error of their ways.

Instead, you should build your company's strong points around such benefits as prompt, dependable service, satisfaction guaranteed, expertise on specific brands, or other proven business builders.

There is, of course, much more to the delicate art of creating successful Yellow Pages advertising and spending ad dollars wisely. These few pointers are intended only to kindle your interest in this most important management challenge. At least two excellent books on the subject have been released in the past couple of years. Investing a few dollars and a little time to buy and read one could be a very profitable move for you. I hope that you'll follow through. ■

Lynott is president of W.J. Lynott, Associates, a management consulting firm specializing in profitable service management and customer satisfaction research.

Mastering IC Electronics, By Joseph J. Carr; TAB Books; 416 pages; $19.95 paper, $32.95 hard.

This book tackles all the complexities of IC electronics, giving readers all the data they need to become proficient in the theory and operation of integrated circuitry. The book covers IC timers, oscillators, and all types of waveshape generators. The book is geared toward the broadest segment of the non-professional electronics market - home experimentors and technical school students who have a basic understanding of ICs but who have not yet reached an advanced level of expertise. Through a unique blend of principles and practical experiments, the books gives readers a full working knowledge of component specifications, design standards, and applications for all kinds of modern ICs. Filled with hundreds of schematics, illustrations, and equations, Mastering IC Electronics is bound to make this solid-state technology easier for all electronics enthusiasts to understand.

TAB Books, Blue Ridge Summit, PA 17294

The Electronics Workbench By Delton T. Horn; TAB Books; 264 pages, $18.95.

With such a wide variety of electronic test devices available, deciding which instruments to buy is often the most difficult part of setting up an efficient, well-stocked workbench. Many technicians and hobbyists end up overspending or burdening themselves with a lot of unnecessary equipment, simply because they didn't understand the specifications and features of the products they purchased.

Horn provides a complete overview of things to know to design a permanent or portable workbench that best suits their specific needs. Horn examines each major category of test equipment: multimeters, frequency counters, signal injectors and tracers, digital test equipment, oscilloscopes, LCR bridges and capacitance meters, signal generators, semiconductor testers and more.

Throughout, Horn includes detailed explanations of the characteristics and capabilities of the various models.

TAB Books, Blue Ridge Summit, PA 17294

Handbook for Sound Engineers By Glen M. Ballou, Macmillan Book Publishing, 1,506 pages $99.95.

The Handbook for Sound Engineers details all the essentials of sound, acoustics, and sound-system design, presenting proper installation techniques and performance ideals for virtually any application. With emphasis on detail, the book synthesizes new technology and traditional sound mechanics into a single, audio library. The handbook refreshes readers' knowledge of sound fundamentals with discussions on voice coloration, sound room design and construction, microphone basics, and audio components. The book features unprecedented coverage of acoustics, electronic components, electronic acoustic devices, electronic audio circuits and equipment, recording and playback, design applications and measurements. The handbook covers a variety of topics from Psychoacoustics to Delay to MIDI and Power Supplies, Image Projection and Resistors, Capacitors and Inductors. Other topics include Heat Sinks, Relays, Audio Measurements, Fundamentals of Sound, Compact Discs and Sound System Design.

Macmillian Book Publishing 11711 N. College Ave., Carmel, IN 46032

First Book of Modem Communications By Jack Nimersheim, Macmillan Book Publishing, 242 pages, $16.95.

In this high-tech world, practically all of the information, knowledge, and wisdom of man can be accessed by the touch of a computer key. This telecommunications adventure can prove exhausting, however, without sufficient instruction. The book provides information vital to becoming an efficient user of the most powerful on-line computer services in the world.

The first step teaches users which hardware and software components are best for their individual needs. Once the cords, lines and modem is hooked up, the book teaches users the language so they can effortlessly send electronic messages. Users then move on to engaging in real-time conferencing, file-transfers, and timesaving electronic mail.

Designed with the beginner in mind, the book gives step-by-step instructions about properly installing and configuring a modem, logging on and sending electronic messages, and protecting a system against disastrous computer viruses. The book also gives users access information about Prodigy and CompuServe on-line services. ■

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- *ES&T* readers service all types of consumer electronics products. Including personal computers, VCRs, CDs, TVs and other audio/video equipment.

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Image processor for digital still camera system allows image processing on personal computers

Toshiba Corporation announced today that it has developed a prototype image processor for the company's proprietary digital still camera system. Connected to personal computers, the processor allows pictures taken with the camera to be displayed and freely processed on the computer screen.

The new development will expand the application of the digital still camera system into areas where the ability to use and edit visual data is indispensable, such as desk top publishing and business presentations.

When used to support desk top publishing, for example, the new processor allows images taken with Toshiba's memory card camera to be quickly downloaded to personal computers, where they can be directly edited and manipulated.

The image processor (PI200) converts image data stored on a memory card into TIFF or Raw data format recognizable by personal computers. Transferred to a PC via the SCSI (the standard data interfaces for small computers), the images can be imported into conventional image processing software and displayed in full-color or monochrome. The conversion and transfer process takes approximately three seconds for a single picture.

Modified or edited images can be saved to the computer's hard disk or the digital camera system's memory cards. When stored on the latter medium, images can be reproduced on conventional television sets via portable "memory card player", allowing them to be easily displayed almost anywhere.

The image processor is compatible with the entire range of personal computers and workstations that support the widely used SCSI interface.

The still camera which stores still images on memory cards, offers these advantages:

1. Images are stable and have a higher resolution
2. Better hard copy can be obtained with a video printer
3. Image quality does not deteriorate during repeated copying and transmission
4. The digital system is easily linked to information processing and telecommunications equipment and expands their capabilities by making it possible to maintain image files and reference systems and to transfer image data over networks.

Toshiba has already marketed a digital still camera system, consisting of:

1. a memory card camera
2. image memory cards
3. a memory card player for reproduction of images stored on memory cards to TV monitors
4. a memory card camera interface which supports a file and reference system and transmission of images to personal computers. ■

Readers' Exchange

Reader's Exchange has been reinstated as a free service.

The following restrictions apply to Reader's Exchange:

- Only individual readers may use Reader's Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Reader's Exchange.
- Readers Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Reader's Exchange submissions to:

Reader's Exchange
Electronic Servicing & Technology
76 N. Broadway
Hicksville, NY 11801

WANTED

Fisher #550 tuner circuit boards. *McIntrye's, 1250 Autumn Dr., Tampa, FL 33613. (813) 977-4578.*

Need schematic and or service manual for an Elgar model SPR 401, an uninterruptible power supply. Made by Elgar Corp of San Diego. *Edgardo Ortiz 582 Rambla Ponce, PR 00731.*

Thick film voltage divider P/N 1906 for Sylvania CK3000 test Jig. Please state price. *Happy Valley, TV 501 Roosevelt St. Exeter, PA 18643 (717) 693-2820.*

Zenith transformer part number 95-2698, Bear Cat scanner model 250 transformer number TC-654-01. *August Aubert (509) 525-3138*

Guides, catalogs or data manuals for semiconductors parts (ICs), manufactured and marked with abbreviation NCR (for replacement). *Steve Poekla 123 N. Newport Ave Ventnor, NJ 08406.*

For Emerson EC101R color TV high voltage transformer- pArt No 4221071021 for G.E. color TV CH. AC-B High voltage transformer Part NO. EP-77x45 focus divider - Part No. EP 14 x 172. *Sam Perlman 7513 E. Camino de Querabi Tucson, AZ 85715 (602) 296-5904.*

25VEHP22 Pix tube, RCA CRK 22A or ECG RT122 Remote for XL-100 TV. *John Phipps 1412 Navaho Trail, St Charles, MO 63304.*

Scematic for a Fidela 33 stereo tape recorder, serial 30227 made by Nakamachi Research Inc. *DJ Aijala 50 Fir Circle Babbit, MN 55706.*

Need service data, manufacturers address, etc., for a Nippon Electronic Model P415E turntable. Although this has an "NEC" logo, it is Not supported by NEC technologies in Wood Dale, ILL.

Schematics for EICO signal generator model 324, also need operating instructions for this unit. Also need operating instructions for Sencore "Cricket" transistor checker model TF 26. Good copies will do. *mike O'Neal 201 South Main, Miami OK, 74354.*

Service schematic and or Zenith manual SR-10 for Zenith Model set S-1992W. Will copy and return manual and or schematic or purchase outright. *Frank Massi Midwest TV 714 Walnut Dr.* #310 Darien, ILL 60559.

Manufacturers Parts and Literature Directory

This monthly section is sponsored by manufacturers to help you find the parts and technical literature needed to service their equipment. Call them for replacement parts or for the name of their nearest distributor.

Hitachi Home Electronics **401 W. Artesia Blvd.** **Compton, CA 90220** **800-HITACHI**	**Mitsubishi Electronics America** **5757 Plaza Drive** **Cypress, CA 90630** **800-553-7278 fax 800-825-6655**	**Panasonic** **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-447-4700**
Philips ECG **1025 Westminister Drive** **Williamsport, PA 17701** **800-526-9354 fax 800-346-6621**	**Quasar** **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-447-4700**	**Technics** **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-447-4700**
Thomson Consumer Electronics **2000 Clements Bridge Road** **Deptford, NJ 08096** **800-257-7946 fax 800-524-1498**	**Zenith Electronics Corp.** **1900 N. Austin Avenue** **Chicago, IL 60634** **312-745-2000**	Call Jonathan Kummer at 516-681-2922 to reserve space in this special section.

Readers' Exchange

Schematic for Capehart color TV. Model #1300A 13" chassis #M3C2-1B. *Baxter C. Horan 25 Grove Highland Park, MI 48203.*

Radios and TVs pre 1951 for my collection. I will pay high prices check your cellar for money. *S. Fogel 87 Sandra Dr. Parsippany NJ 07054 (201) 316-8461.*

Factory TV-VCR service manuals for RCA, Sony, Hitachi, and Panasonic 1985 on. *Arundel TV, 170 B Ritchie Hwy, Severna Park, MD 21146 (410) 647-4846.*

FOR SALE

Sams photofacts #500 to #863 164 photofacts for $85.00 plus shipping. RCA minichroma bar generator model #WR-508 good condition $50.00 plus shipping. *John Brouzakis 247 Valley Circle Charleroi, PA 15022 (412) 483-3072.*

Sams #29 thru 1626, some missing, tubes and Heath B&K, Sencore and Eico test equipment. Write for list. *Stan Klostermann, 495 Bluff Dr. St. Louis, MO 63137 (314) 868-3667.*

Leaser semiconductor curve tracer # LTC905. Just out of warranty $250.00; B&K 5MHz pulse generator #3300. Main and auxiliary outputs, different modes and fully adjustable pulse characteristics $300.00. *Ron Grega 107 Ridgeview Dr. Dunmore, PA 18512 or (717) 347-6842.*

Back issues of ES&T 1963 to 1970 also 1978 to 1991. One issue each 1960 and 1962. *Avery Penny 9318 Marilyn St. Plymouth MI 48170. (313) 453-0364.*

Rider television manuals volumes 1 thru 14 for years 1948 to 1954. Make an offer. *Jack Murchak 16600 North 700 West, Demotte, IN 46310.*

B&K 1570 quad tester 70MHz oscilloscope like new 850.00. B&K 1560 treble trace 60MHz oscilloscope like new 800.00. B&K model 1251 NTSC color bar generator like new 850 and B&K model 1803 100MHz frequency counter like new $120.00 all for $2,500 please call. *Bill Dowdy (209) 836-0810.*

Nutronix TR100CB camera light box with 4 transparencies $225 postpaid. Call *Dave Burleson (915) 683-6002.*

Sencore VA 6Z and SC61 1/2 and B&K 520 B. *Robert Nelson 1458 Black Foot LN, Lake Havasu, AZ 86403.*

Heath IT-21 Emissions type tube tester w/roll chart, update, extra adapters. Asking $75 plus shipping. *BJ, 13 Doe Lane, Malvern, PA 19355.*

B&K oscilloscope, model 1440, 10MHz, single trace, $85, heathkit model IT-5230 3-Meter CRT tester, $95. Plus other test equipment. *Gene Bartley, 1805 Sylvia, Arkadelphia, AR 71923, 1-501-246-7234.*

24 electronic manuals, 3858 pages, hundreds of schematics/diagrams. $55.00 postpaid. 755 new electronic tubes in their original boxes $375. Send a LSASE (2 stamps) for lists. Transistors, TV parts, test equipment, electronic books, and electronic courses. Send a LSASE (2 stamps) for lists. Retiring. *J. Horsley 67 Theodore Street, Buffalo, NY 14211.*

Sencore LC53 Z meter like new $390.00. Hitachi dual tracer model 422 oscilloscope like new in box $500.00. *Alex Minelli (218) 263-3598.*

Classified

Classified advertising is available by the word or per column inch.

By-the-word: $1.65 per word, per insertion, pre-paid. Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 additional. No agency discounts are allowed for classified advertising by the word. Contact Emily Kreutz at 516-681-2922 to place you classified ad (by-the-word). Or send you order, materials and payment to Emily Kreutz, Electronic Servicing & Technology, 76 North Broadway, Hicksville, NY 11801.

Per Column Inch (Classified Display): $235 per column inch, per insertion, with frequency discounts available. 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising please contact Jonathan C. Kummer at 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

FOR SALE

SENCORE: Waveform analyzer model SC-61, NTSC pattern generator model NT-64, VCR test accessory model VC-63, universal video analyzer model VA-62, variable isolation transformer and safety analyzer. **B & K:** Solid state sweep marker generator model 415, DC power supply model 1611. **LEADER:** NTSC vectorscope model 585OC, TV multi channel sound generator model LMS-238, waveform monitor model 586OC. **BELL AND HOWELL:** Microfish reader model M601. **ECO:** TV sweep generator and marker model 368. Call for price. 803-448-8474 (day) or 803-449-1486 (eves) ask for Michel Berda. 2-92-1t

REPAIR MANAGEMENT SOFTWARE: for IBM PC's. Repair tracking, inventory, reports, billing, maillist, more. Demo disk $15. CAHILL ELECTRONICS, PO Box 568, Kingston, NH 03848. 603-642-4292 1-92-2t

PHOTOFACTS: Folders under #1400, $5.00. Above #1400, $7.00, sent same day first class postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 516-481-4380. 2-92-5t

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5 1/4" IBM Compatible disks. 1,000 VCR, Printout $83, Disks $72. 5,400 TV, Printout $135, Disks $113 (Hardrive). Two solutions pays for it. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903. 2-92-6t

VHS-VCR REPAIR SOLUTIONS SETS I,II,III,IV,V,VI. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each all six $59.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 1-92-2t

FOR SALE: 8 TECHNICIANS AND THEIR TRAINING. 5000: ACTUAL CURRENNT "TECHNICIAN" TECH-TIP REPORTS: Symptoms, Cures & Part Numbers. 1987 Through 1991. TV-VCR-CD-LD-CAMERA-CAMCORDER-PROJECTION-STERO-AMPLIFIERS-SATELLITE-MICROWAVE-CASSETTES-PHONO-ETC. We service All Consumer Electronics and Factory Authorized for 36 Major Manufacturers. If it came through our doors, it's on it's way to "YOURS"! FOR OUR BOTTOM PRICE SEND $15.00 FOR DEMO DISK OR $10.00 PRINTED FORM. $70.00 per 1000 data-base disk price or $350.00 for 5000, Printed form add $5.00 Per 1000 Tips. Annual updating available. AMEX-M/C-VISA & CHECKS, 2-Wks Delivery 305-474-2677 Factory Service 8614 SR-84, Ft. Lauderdale, FL 33324. 8-91-12t

CROSS REFERENCE FOR IC'S: Generic to manufacturers of major Japanese companies. Sent $19.95 to COBB ELECTRONICS, P.O. Box 675764, Marietta, GA 30067-0021. 2-92-2t

TV TOUGH DOGS 300 symptoms and cures. Send $10.95 to Davis TV, 11772 Old Fashion Way, Garden Grove, CA 92640. 1-92-2t

VCR HEADACHES? 500 Most common problems and cures. Printout $49. 1300 Symptoms and cures. Printout and IBM disc. $125.00. Guaranteed satisfaction. VCR Tuneup Center, 43 James Avenue, Redwood City, CA 94063 or call 1-800-777-7883. Mastercard and Visa accepted. 1-92-1t

REDUCED 85%, Diehl Mark 111 scanner $79. Diehl Mark V scanner $199. New. Restore remote control keypads with our conductive coating $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629, 608-233-9741. 12-91-tfb

FOR SALE: Sencore SC61 $1,000. Mint Condition. Odems Electronics, Monroe, WA 98272. 206-794-4461 1-92-1t

B & K: Oscilloscope #2160 $599.00. B & K sweep function generator #3020 $225.00 - Sencore VA62A $1999. 701-523-3570 or 3606. Loren Steyer. 2-92-1t

REPAIR: copiers with INTRAVIA'S SERVICE GUIDE. Written for technicians who not necessarily have a copier background, the ILLUSTRATED EDITION to PERSONAL COPIERS covers most troubleshooting and repair procedures on smaller Canon and Sharp brand copiers. $25.00. Knight Business Systems Ltd., 266 Middle Island Road, Bldg. 2-13, Medford, New York 11763. Phone 516-736-4440. FAX 516-736-4228. 2-92-1t

MISCELLANEOUS

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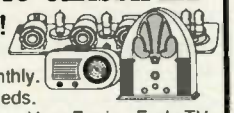

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BGI Company	60	73	219-277-8762
C & S Sales	IBC	3	800/292-7711
CUI Stack, Inc.	47	74	503/643-4899
Cahill Electronics	60	75	603-642-4292
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Heath Company	5	78	800-444-3284
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Hitachi Home Electronics	59		800/HITACHI
Iscet	10		817/921-9101
International Components Corporation	60	80	800/645-9154
Jesse Jones Industries	20		800-825-6690
Kelvin Electronics	60	81	516/349-7620
MCM Electronics	19	82	800/543-4330
Mitsubishi Electronics America	59		800/553-7278
NESDA	19,53		817/921-9061
Panasonic	59		800/447-4700
Panavise Products	37	83	702/353-2900
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Quasar	59		800/447-4700
Russell Industries	37	91	800/645-2202
Sencore	IFC,7	92,93	800/SENCORE
Sperry Tech	60	94	800/228-4338
Technics	59		800/447/4700
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S-1325

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SL-30 $99
Digital Display
Temp Range: 300F-900F
Grounded Tip
Overheat Protect

Video Head Tester

HT-200
$55.95
Tells you if VHS head is defective or worn
A must for VCR work

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F-100 120MH
$179
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Frequency, Period, Totalize, Self Check with High Stabilized Crystal Oven Oscillator, 8 digit LED display

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$59.95
2-20V @ 2A
12V @ 1A
5V @ 3A
-5V @ .5A

Fully regulated and short circuit protected

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Assembled $69
Kit $45
2 to 15V @ 1A,
-2 to -15V @ 1A
(or 4 to 30V @ 1A)
and 5V @ 3A

All the desired features for doing experiments. Features short circuit protection, all supplies

AM/FM Transistor Radio Kit with Training Course

Model AM/FM 108
$26.95
14 Transistors • 5 Diodes
Makes a great school project

True RMS 4 1/2 Digit Multimeter

M-7000
$135
.05% DC Accuracy
.1% Resistance
with Freq. Counter and Deluxe Case

GF-8016 Function Generator with Freq. Counter

$249
Sine, Square, Triangle Pulse, Ramp, .2 to 2MHz Freq Counter .1 - 10MHz Int/Ext operation

GF-8015 without Freq. Meter $179

Function Generator Bloz

#9600
$28.95

Provides sine, triangle, square wave from 1Hz to 1MHz AM or FM capability

XK-500 Digital / Analog Trainer

A complete mini-lab for building, testing, prototyping analog and digital circuits

Elenco's Digital / Analog Trainer is specially designed for school projects, with 5 built-in power supplies. Includes a function generator with continously variable, sine, triangular, square wave forms. All power supplies are regulated and protected against shorts.

Power Supplies
- Variable Power Supply
- +1.25 to 20VDC @ .5 Amp (+1.25 to 15VDC @ 1 Amp)
- -1.25 to -20VOC @ .5 Amp (-1.25 to -15VDC @ 1 Amp)
- +12VDC @ 1 Amp
- -12VDC @ 1 Amp
- +5VDC @ 1 Amp
- 30VAC Center tapped @ 15VAC @ 1 Amp

Analog - Section
- Function Generator Sine, Triangular, Square wave forms
- Frequency adjustable in five ranges from 1 to 100KHz
- Fine frequency adjust
- Amplitude adjust
- DC offset
- Modulation FM-AM

Digital - Section
- Eight data swiches
- Two no bounce logic switches
- Eight LED readouts TTL buffered
- Clock frequency 1 to 100KHz
- Clock amplitude 5VPP square wave

Breadboards
- 2 breadboards, each contain: 840 tie points (total 1,680)

149.95 Assembled
119.95 Kit

Learn to Build and Program Computers with this Kit

Includes: All Parts, Assembly and Lesson Manual

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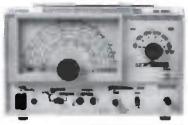

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